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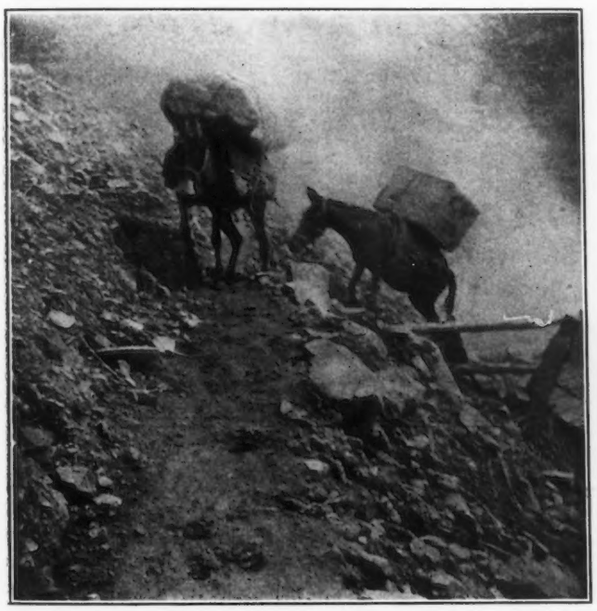
Reminiscences of Mining in Durango

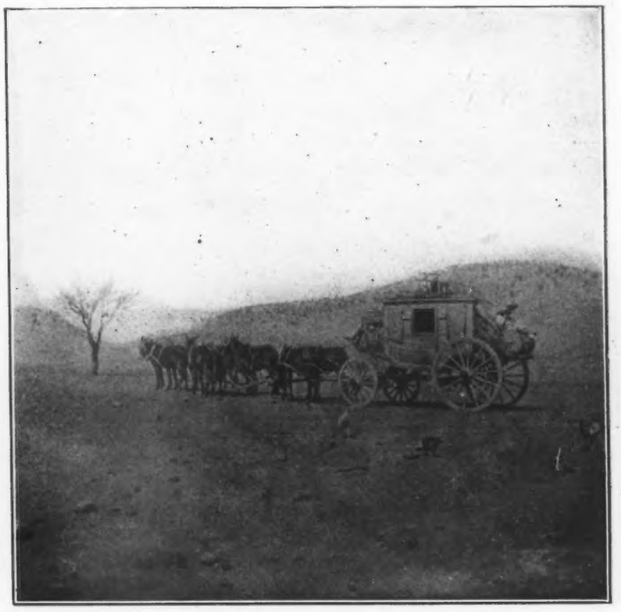
Improvements in Railroad Facilities. Establishment of Law and Order. Some Data about a Crude but Profitable Smelting Practice

BY WALTER D. BEVERLY

My first visit to Mexico was in 1892. At that time the American invasion was well under way. Since 1886 the mines of Sierra Mojada had been exporting large quantities of lead ore to the United States, and in 1889 the McKinley tariff bill, making lead in ore dutiable at the rate of 1½c. per lb., had led to the establishment of a silver-lead smelting industry at Monterey and San Luis Potosi, the development of which greatly reduced the supply of Mexican ore available for reduction by American smelters and gave a great impetus to mining in Mexico in general. The trunk lines of railway from El Paso, Eagle Pass and Laredo, to the city of Mexico had been constructed, affording a vast improvement to the means for transportation in the republic. The construction of branch lines was already being undertaken, but as yet these had not progressed far, wherefore, traveling away from the main lines of railway was slow and tedious. We were able to go on a construction train from Torreon to Pedriceña, where we spent a part of the night. Being awakened shortly after midnight, we entered the *diligencia*, which left at 1 a.m. to make a continuous run to the city of Durango. The stage was of the regulation Concord type, but the harnessing of the horses was novel to me. There were two wheelers, three "swings" and three leaders. Besides the driver there was a "whipper," who rode on the footboard, but jumped off and ran along with the team when whipping was required. Horses were changed about every 15 miles and the stage made good time. There were nine persons inside, and every seat on top was occupied. I had a seat inside, which I chose as the more comfortable in the cool hour of the early morning when we departed from Pedriceña, but as the day wore on I became very uncomfortable, and felt like a sardine in a tin box, so tightly were our arms and legs packed inside of the coach. We arrived at Durango at midnight, and I alighted from the stage with the feeling that 23 hours of continuous traveling in a *diligencia* with nine persons inside was an experience that I did not care to repeat.



A HARD BIT OF TRAIL



THE SANTIAGO STAGE

Early Lawlessness—Hard Times

From Durango we went to Santiago Papasquiaro, again by stage, but in a more leisurely manner, being two days on the road. Our mines were near Santiago. This was a more or less troublous time in that part of Mexico, which was still remote from the railways and from the strong hand of law and order. The famous bandit, Heraclio Bernal, who infested this part of Mexico, had been killed only a short time previous, and the remnants of his band were still active. Highway robbery and murder were common, as was generally the case in hard times, as these were. Consequently, it was necessary to take precautions for safety at which anyone in Mexico at the present time would laugh. Often our *hacienda* would be aroused by the warning that the bandits were coming (although they never did), and no one ventured on a journey without going well armed and well guarded. The murder of one of our own superintendents on his way out to the mines manifested that these precautions were not idle.

I have previously remarked that this was a period of hard times in this part of Mexico. This was due to the failure of the corn crop, because of the lateness and deficiency of the usual rains. The government of the State sought to relieve the distress by importing corn from the United States, and on my way to Durango I saw poverty-stricken and hungry *peones* pick-

ing up, kernel by kernel, corn that had dropped from the Government wagons. At our own camp, the mules in the *corral* were fed regularly under the guard of men armed with rifles to prevent the people from stealing the corn. It wrenched the heart to see lean women and ill-fed children gazing longingly through the bars at the mules enjoying the corn that was only for them; but this was not a matter for false generosity, because all of our hoisting was done by *malacate,* and if the mules were not kept in proper condition, we could not operate the mines that employed the people, in which event, of course, they would have been much worse off. We paid one peso per day to miners and 75c. to *peones.* Since then wages have risen materially, especially in some camps like Cananea.

In this camp, we did not experience any great hardships, there being a fairly good wagon road all the way into Durango. We built a large concentrating mill and had no difficulty whatever in bringing in the heavy machinery on ox-carts. This was not done, however, until after the mines had been developed, which, as I have remarked above, was accomplished by the aid of *malacates.* Previous to the construction of the concentrating mill, we did not have any steam engine. We had abundant timber from which we could saw good lumber, and we had some fairly good material with which to make brick. When I returned to the United States after a little more than a year, the railway had been completed to Durango, and it was a great relief after the stage journey of three days to be able at that place to step into a Pullman car.

In the Sierra Madre

My next visit to Durango, for a long sojourn, was in 1895. At this time I was engaged at mines to the west of Durango, which we reached by a four-days' journey on mule back from Durango, or by two days of staging to Santiago Papasquiaro, and thence three days southwesterly by mule back. The mines were situated in a rough country, which can never be reached by wagon road—much less by railway—and we were solely dependent upon mule transportation. During the rainy season we were quite cut off from communication with the outside world, the trail being impassable, wherefore it was necessary to lay in an ample stock of supplies in advance. It would generally happen, however, sooner or later, that we would run out of some necessary article. One summer, I remember, our supply of lucifer matches gave out long before we could hope to replenish it, and we were then obliged to resort to the use of flint and steel whenever we were away from the camp where a constant fire was maintained. This gave us an idea of the inconveniences with which our ancestors had to put up.

Our camp was situated in the midst of the main ranges of the Sierra Madre, at the bottom, and on the western side of a *quebrada,* or cañon, leading into a larger cañon that was the course of a considerable stream. The smeltery and *hacienda,* at the bottom of the cañon, were about 4300 ft. above sea level, the adjacent mountains rising to an elevation of about 8000 ft. The country was exceedingly rough, the mountain sides pitching at a slope of 35 deg. or more, with only a few mesas, or shoulders, that were so much as comparatively level. Wagon roads were quite impossible, and communication was necessarily done by pack animals.

The climate was healthful. During two years of observation, the maximum temperature was about 95 deg. F., and the minimum about 32 deg. The rainy season began about July 1 and continued to about Oct. 1, during which time there were heavy showers every day. During the remainder of the year there was no rainfall except occasional light showers in February. At this latitude (about 24 deg. north) there was never any snow at the elevation of 4000 to 5000 ft., but in the sierras above the latter elevation there were frequently falls of 12 to 18 in., and snow to the depth of 3 or 4 ft. could be measured on the ground during what was said to be an unusually severe winter.

Even in the short time that had elapsed since my previous residence in Durango there had been a marked change in conditions. There was no longer any general fear of bandits and no one took the trouble to go armed unless he was bound on a long journey away from home. In the course of two years, but one of our supply trains was held up, and this was for robbery only, without the accompaniment of murder. As soon as this was reported, our *jefe accordada* started in pursuit and eventually killed all of the robbers, together with those who harbored them. These were harsh measures, but it was by such that Diaz in his wisdom made it possible to conduct business in Mexico. The country experienced what has been appropriately called civilization by bloodshed. The traveler is now able to go almost anywhere in Mexico with perfect safety. In my last visit to the Republic, I went into the Yaqui country without any concern whatever.

A SMELTERY IN THE SIERRA MADRE

A TARUJUMAR INDIAN

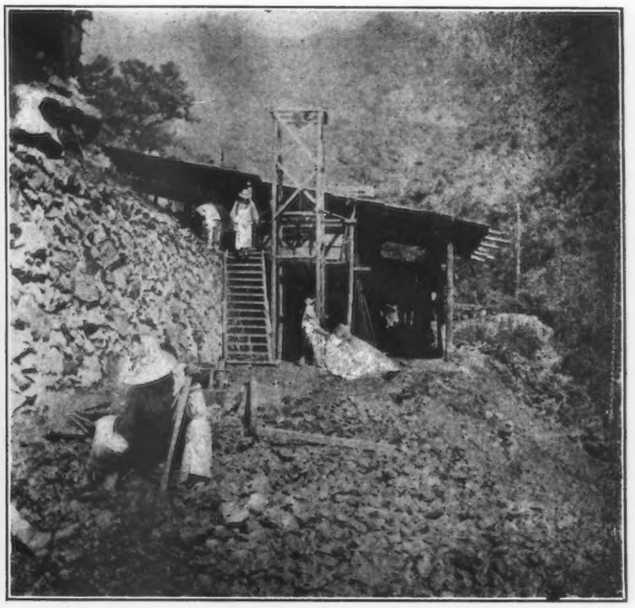
Description of the Mine

Our mine was opened on a fissure vein

containing a rather narrow but fairly persistent streak of ore composed of quartz, pyrites and blende, with a little chalcopyrite and galena. Near the surface this ore had been oxidized and leached, leaving a silicious residue containing an ounce or so of gold, which had been worked by the natives. When they got down to the mixed sulphides, they could not, of course, do anything with it. The attention of the American owners of the property was originally called to it by a Mexican miner. The Mexican is the best of prospectors, and through long generations has scoured carefully over his mountains. In all of my experience in Mexico, I have never known of the discovery of a really new ore deposit (except some blind lode). All of the mines that I have seen have been old workings, exploited by the natives to the limit of their capacity, mining and metallurgical, and their ability and ingenuity have been no mean things as everyone who has lived in Mexico knows.

Our sulphide ore contained about 50 oz. silver and 1 oz. of gold per 2000 lb. It was essentially a mixture of pyrite, blende, galena and chalcopyrite, with a gangue of quartz. In addition to the above sulphides there were arsenopyrite and jamesonite in small quantities. The gold of the ore occurred chiefly in the pyrite and chalcopyrite. The silver occurred in the form of tetrahedrite, sometimes so abundantly that the ore could be sorted for direct shipment, but the amount of this class was small. The galena occurred chiefly in a distinct band in certain parts of the mine and could be easily separated by sorting; it carried no gold, but was richer in silver than the average ore, containing from 75 to 90 oz. per 2000 lb. An analysis of 15 tons of the pyritous ore, which was a representative sample, gave the following results: 18.1 per cent. silica; 1.12 alumina; 1.28 ferrous oxide; 29.8 iron; 13.3 zinc; 1.18 copper; 0.4 lead; 34.18 sulphur; traces of antimony and arsenic; total 99.51. This analysis indicated a mineralogical composition approximately as follows: 20 per cent. quartz; 27 per cent. blende; and 53 per cent. pyrites, chalcopyrite and arsenopyrite. The blende was uniformly black and ferruginous, pure selected specimens showing a content of only about 50 per cent. zinc. The basic character of this sulphide ore enabled us to smelt along with it a considerable portion of the silicious ore from the upper part of the vein. This silicious ore contained about 65 oz. silver and 0.8 oz. gold, per 2000 lb., 22 per cent. ferric oxide, 1.7 per cent. zinc, 0.3 per cent. copper, 5.4 per cent. lead, 3 per cent. sulphur, and 51 per cent. silica.

SMELTERY IN BLAST



THE SLAG DUMP

Working Conditions

The mine was so situated that it could be worked to a depth of 300 or 400 ft. through adit levels. In Colorado it would have been a good little property, but at a place in Mexico whence freight to the nearest railway station cost about 54 pesos per ton, it was not so good. However, we were able to make money out of it, and if we had had more means to increase the scale of our operations in the earlier stages we could have done much better. This is a case of a mine which paid for itself from the grass roots, and we were not able to install improved working appliances until we obtained from the mine itself the money to pay for them.

The vein dipped at an angle of about 85 deg. The country rock was a hard, finely crystalline granite. The pay streak, although clearly defined, was rarely separated from the inclosing rock by an actual parting, and being very hard, as was also the country rock itself, it was not easy to break the ore cleanly from the wall, and a subsequent sorting was consequently necessary. The average thickness of the pay streak throughout the mine was about 20 in., the maximum being about 50 in. The cost of production per 2000 lb. of hand-sorted product was about 25 pesos. Transportation by burro from the *patio* to the roasting stalls cost 53c. per 2000 lb. In the development of the mine the ground did not require any timbering, except occasional stulls. Driving drifts, 6x4 ft., cost 6 to 9 pesos per linear foot, according to the ground; raising, 4x4 ft., 6 to 8 pesos; sinking winzes, 6x4 ft., 8 to 12 pesos. All of this work was done by contract. Everything possible, both in the mine and about the *hacienda,* was done by contract or by stint. Either of these methods brings out the maximum efficiency of the Mexican, and under their conditions he is an admirable workman.

The Smeltery

Obviously, the only thing that we could do with the ore was to concentrate its value into a matte. We had a little smelting furnace, 30x30 in., which was largely of homemade construction. It was a brick shaft (bricks made on the ground) in the panels of which were placed four wrought-iron water jackets, obtained in Durango. We had a little teakettle of a boiler (15 h.p.) riveted up on the ground, a 12-h.p. slide-valve engine, and a No. 6 Sturtevant fan, together with a few slag pots, and some cast-iron spouts for matte and slag. Almost everything else was homemade. For our lumber we began with the trees in the forest, whipsawing them into planks and boards, and we used earth that we tried to make ourselves believe

was clay suitable for brick making. The smeltery as a whole was similar to those that I saw at Eureka, Nev., in the early '70s. I have forgotten what the plant cost us, but it was only a few thousand dollars. After it was running, the only supplies that we brought in from Durango were nails, bolts, pipe, bar iron, and the like. The fuel was charcoal and the product of the furnace was matte.

Treatment of the Ore

We could not easily smelt the run-of-mine ore. It contained too much zinc, and in our roasting stalls (built of *adobe*, by the way) we could not oxidize the blende to any extent. As everyone knows, raw blende does not smelt well in a furnace 30x30 in., so we used to sort the ore by hand, on the *patio*, culling out a little that was rich in gray copper, rich enough in fact to be a direct shipping product, picking out and casting aside the blende and smelting the pyrites, after roasting in the stalls. However, this did not pay, because we lost too much silver and gold in the zinky stuff that was rejected. After some experimenting, we managed to effect a fairly good oxidation of the blende in treating run-of-mine ore, and then by making a slag that was rather high in zinc, we were able to operate successfully, although the running of the furnace was very slow and its campaigns were very short. However, when it froze up it was a comparatively simple matter to clean it out and start over again.

We concentrated the value of 10 tons of ore into one ton of matte, the latter assaying 8 to 9 per cent. copper, about 8½ oz. gold, and 400 oz. silver per ton, the recovery of copper, gold and silver being 85, 85 and 80 per cent., respectively. The loss of metals was high, partly because our slags were dirty and partly because we had no means for collecting flue dust. From some points of view, our metallurgical practice was not very good, but it enabled us to develop the mine and make some money, so that later we were able to improve the works. Probably there are many mines at remote places in Mexico, even today, which could be profitably developed, without any great requirement for capital, by some rough metallurgy such as we practised.

Hand Sorting

The sorting of the ore on the *patio* was a source of high expense. At first this was done in the regulation Mexican fashion, the men and boys sitting around the *patio* on their haunches, each with a little pile of ore in front of him, laboriously breaking up the pieces by means of a small cobbing hammer. This expense was greatly reduced by the introduction of a little common sense. A sorting house was constructed, wherein the ore was received upon an upper terrace, where a gang of men broke it to macadam size by means of long-handled hammers, of which the head was about 6 in. long, forged from a piece of 1½-in. octagonal steel, weighing a little less than 3 lb. With these hammers the ore breakers stood up to their work, and thus they were able to break a good many tons of ore per man at no very great cost. The broken ore was pushed over the edge of the terrace, passing over a grizzly that extended the whole length of the breaking floor. The fines that dropped through the grizzly were used as covering in the roasting stalls. The coarse fell into a long bin, from the bottom of which it was drawn out by the sorters upon a bench in front of the bin. In the bench before each sorter there was a series of small holes, through which he dropped his product into sacks hanging below. When a sack was full there was nothing to do but remove it, tie it up, and put it aside, pending the time when it would be taken by burro to the roasting stalls, or other destination.

Stall Roasting

At the roasting stalls the sacks of ore were dumped directly into the stall to be filled, the burro train passing through the house on a bench at the back of the line of stalls. The roasting stalls were, of course, unloaded by hand, the product being shoveled into wheelbarrows, by which it was carried across the yard in front of the stalls to the head of a gravity tramway (of homemade construction) by which it was lowered to the feed floor of the blast furnace. In the stall roasting the sulphur in the ore was burned down to about 8 per cent., which was about what was required to make matte in the subsequent smelting when the ratio of concentration was 10:1. At any higher ratio of concentration the matte-fall was too small to keep the hearth and settler of our little furnace in proper working condition. The cost of roasting in the stalls, at the rate of 300 tons per month, which yielded 220 tons of product, was as follows (values in pesos):

Foreman	75.00
1 man, 26 days, at 1.50	39.00
1 man, 26 days, at 1	26.00
40 cu.yd. cord-wood at 1	40.00
40 cu.yd. split wood at 45c	18.00
Unloading 30 stalls at 2.50	75 00
Total = 1.25 per ton =	273.00

Smelting

Our cost of smelting per month was approximately as follows, all the values being in pesos. We could make a monthly campaign of about 20 days, smelting 220 tons of ore.

LOADING MATTE

LOADING MATTE

			Pesos
1. Salaries:			
1 furnaceman at 145 per month	145.00		
1 machinist at 105	105.00		
1 machinist at 45	45.00	=	295
2. Transport:			
1 man, 20 days, at 1.50	30.00		
2 men, 20 days, at 1	40.00		
Supplies, wear and tear, etc	10.00	=	80
3. General Expense:			
1 carpenter, 25 days, at 2	50.00		
1 smith, 25 days, at 1.50	39.00		
1 watchman, 10 days, at 1	10.00		
Material	40.00	=	139
4. Assaying:			
1 man, 26 days, at 1.75	45.50		
Charcoal, 2500 lb. at 1c	25.00		
Supplies	25.00	=	95.50
5. Matte House:			
Breaking 22 tons matte at 2	44.00		
Sacking at 10c. per sack	28.00		
Sacks, twine, etc	15.00	=	87
6. Furnace Labor:			
4 furnace men, 20 days, at 2	160.00		
4 helpers, 20 days, at 1.25	100.00		
1 slag-dump man, 20 days, at 1.25	25.00		
2 slag-dump men, 20 days, at 1	40.00	=	325
7. Fluxes and Fuel, etc.:			
140,000 lb. charcoal at 1c	1400		
40 tons lime at 5	200		
53 cu.yd. wood at 1	53		
Miscellaneous supplies.	50	=	1703
8. Furnace Repairs:			
80 sacks loam at 5c	4		
500 brick at 32 per M.	16		
20 firebrick at 40c. each	8		
3000 lb. clay at 40c. per 300 lb	4		
20 sacks charcoal dust at 25c	5		
40 sacks yellow clay at 5c	2		
Labor	20	=	59
Total = 12.70 per ton =			2783.50

The pots full of matte from the furnace were run to the matte yard, where they were dumped when cold, the cones of matte then being taken into the matte house, where it was sledged to about macadam size, sampled by reserving every 10th shovelful, and put up in cotton sacks over which *sacate* was sewed, each sack holding 150 lb. and two sacks being the load for a mule. The freight rate to Durango was generally eight pesos per *carga* of 300 Mexican pounds, or 138 kg., which was equivalent to $29.44 gold per ton, figuring exchange at $1.97. We seldom had any difficulty in securing transportation, inasmuch as the *arrieros* coming to our camp obtained loads each way, bringing in mining, smelting and general supplies and carrying out ore and matte, and sometimes we were able to obtain a rate of only seven pesos per *carga*. At Durango the matte was sold for 95 per cent. of its silver content at current New York quotation, gold at 61c. per gram and copper at 15.4c. per kg., less a treatment charge of $12 (gold) per metric ton. This rate did not allow for the Federal tax of 3 per cent. of the gold and silver.

Cost of Labor and Material

The cost of labor and of mining, smelting and general supplies is of some interest, as given in the following list:

Wages.	Pesos.
Carpenters	1.50@ 2
Smiths	2
Masons	2
Laborers	1.00@ 1.25
Miners	1.50
Furnacemen	2

Contract Prices for Work.	
Driving, 6 × 4 ft	6@ 9, according to ground
Raising, 4 × 4 ft	6@ 8, according to ground
Sinking, 6 × 4 ft	8@12, according to ground
Unloading roasting stalls	2.50 per stall
Splitting cordwood	35c. per cubic yard
Sacking ore and matte	10c. per sack

Mining and Smelting Supplies.	
Charcoal	64c. per 100 lb., delivered
Cordwood	1 per cu.yd., delivered
Plank, 8½ ft. × 12 in. × 12 in	70c. each, delivered
Board, 8½ ft. × 12 in × 1 in	50c. each, delivered
Shingles, 7 in. × 36 in	1.50 per C, delivered
Round Poles, 16 ft. × 5 in	75c., delivered
Round Poles, 8 ft. × 8 in	75c. each, delivered
Adobe brick, 18 × 9 × 4½ in	20 per M, delivered
Red brick, 9 × 4½ × 2½ in	20 per M, delivered
Dynamite	15 per 50 lb., Durango
Caps	13.50 per case, Durango
Fuse	65 per 6000 ft., Durango
Candles, stearine	10.50 per box Durango
Candles, tallow	? per C.
Kerosene	8@ 9 per 10 gal. Durango
Lubricating oil	10@12 per 10 gal. Durango
Steel	13@17c. per lb., Durango
Round iron	8c. per lb., Durango
Castings	7c. per lb., Durango
Firebrick	18c. each, Durango
Slag pots	39 each
Ore sacks	24 per C

Staple Store Supplies.	
Corn	6@ 7 per 300 lb., delivered
Beans	11@12 per 300 lb., delivered
Sugar	9@10c. per lb., Durango
Lard	24@26c. per lb., Durango
Coffee	42@45c. per lb., Durango
Tobacco	18@40c. per lb., Durango
Cotton cloth	9@12c. per meter, Durango

We were not able to obtain any board or plank of greater length than 9 ft., this being the limit for transportation by burro. With any greater length the burro was unable to negotiate safely the sharp turns of the trail. A 2-in. plank, 8 ft. 4 in. long, freshly sawed, weighed 54 lb. Mexican, and four planks constituted a load for a burro. Round poles, 5 in. in diameter at the larger end, could be obtained of length up to 16 ft. These were cut in the mountains and were carried by men to the edge of the *quebrada*, where they were pushed over and allowed to slide down a matter of 1000 or 2000 ft. to the *hacienda*. Under these conditions it will be perceived that construction work involved some difficulty and afforded an ample exercise for ingenuity.

I have gone into these details with the idea that they may be of interest to persons who are developing similar mines with small means in Mexico, even at this late date, because in spite of the great improvements in transportation and metallurgical facilities, there are still many districts in the sierras that are remote and are capable of exploitation only by such rough methods as we used 15 years ago. It is always a satisfactory achievement in mining to make a property pay for its own development from the grass roots downward, and avoid the tedious begging for capitalistic assistance, which anyway is apt to be costly.

Chronology of the Gold and Silver Industry in Mexico, 1521-1890

1521—Conquest of Mexico by Hernando Cortes.

1522—The first silver sent to Europe from the mines of Mexico was obtained from Tasco, discovered by the Spaniards this year. These mines, together with those of Pachuca are considered the oldest in Mexico, some of them having been long worked by the Aztecs at the time of the arrival of the Spaniards.

1540—Work was begun by the Spaniards in the silver mines of Zacatecas.

1548—First discovery of silver at Guanajuato.

1555—The silver mines at Sombrerete, Zacatecas, began to produce.

1557—Invention of the patio process of silver amalgamation by Bartolome de Medina, of Pachuca.

1632—Discovery of the silver mines of Batopilas, Chihuahua.

1666—Discovery of the silver mines of Cusihuiriachic, Chihuahua.

1704—Discovery of the silver mines of Santa Eulalia, Chihuahua.

1762—Discovery of the great silver bonanza of Real del Monte.

1778—The silver mines of Catorce were opened and proved to be rich.

1783—Zambrano discovered the famous silver mines of Guarisamey, Durango.

1792—The famous bonanza at Sombrerete, Zacatecas, was discovered this year, the mines at that place having been worked for more than two centuries.

1793—Mules and horses were used in Mexico, for the first time, for mixing the pulp, mercury and chemicals in the patio process, saving 75 per cent. in the cost of this branch of working; prior to this time, the operation had been performed entirely by human labor.

1798—Discovery of the great bonanza (silver) at Ramos.

1810—Discovery of silver at El Refugio, Chihuahua.

1824—Discovery of silver at Palmarejo, Chihuahua. The silver mines of Fresnillo, Zacatecas, were opened.

1878—Discovery of the silver-lead deposits of Sierra Mojada, Coahuila.

1890—Establishment of the silver-lead smelting industry in Mexico.

Hand jigs, operated by two men and treating from six to seven tons of coarse or four tons of fine material per day, are used with success (*Mex. Min. Journ.* Aug., 1909), at the Progreso mine at Triunfo, Baja California. Little water is required, and wages are only 1.25 pesos a day.

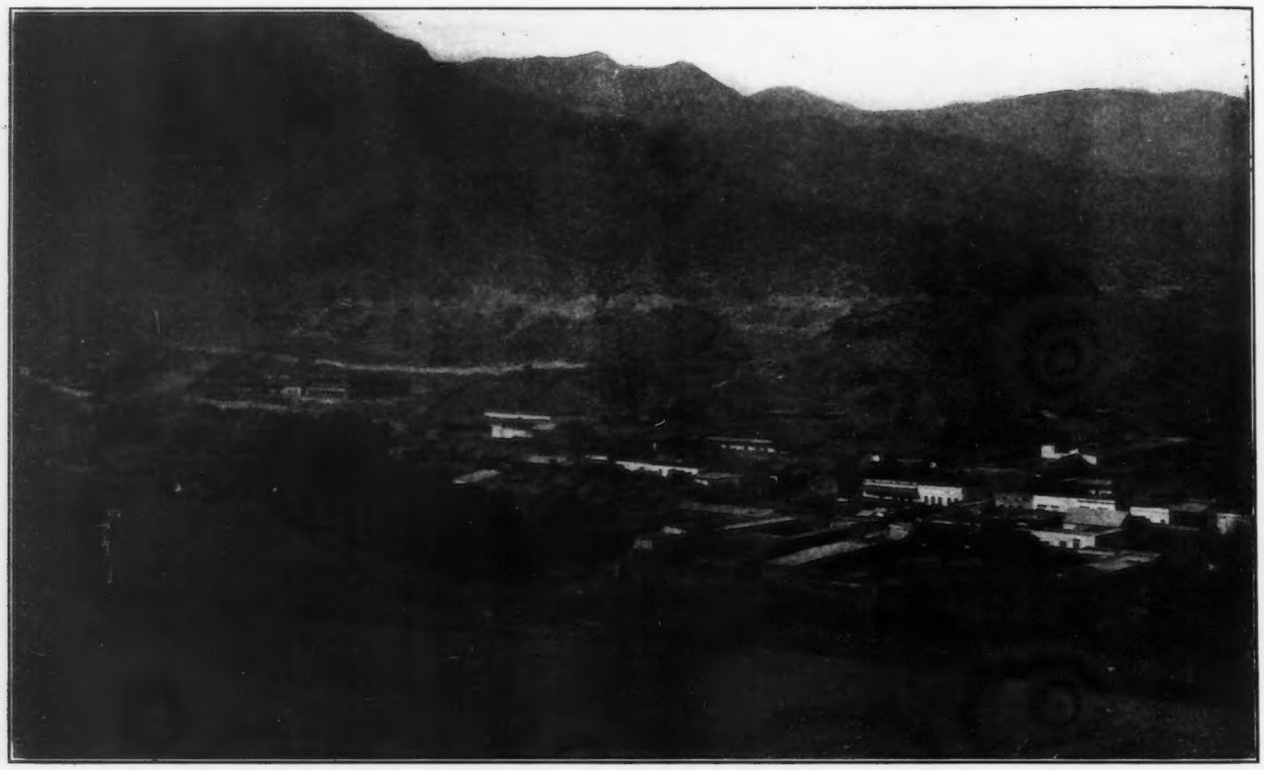
San José de Gracia, a Great Mexican Gold Camp

Discovered by Some Early Spanish Missionaries and Has the Remarkable Record of 90 Years' Continuous Production of Bonanza Ore

BY E. A. H. TAYS*

About 1630 a group of missionaries traveled north and west from Guadalajara along the coast plain to what is now known as the Culiacan river, and founded the town of Culiacan at the place now known as Culiacancito. From Culiacan as a base, new expeditions were started out to explore and presumably civilize the surrounding country.

Ten years later Captain Montoya returned to Sinaloa with a strong company of Spaniards and allies, and this time founded the present town of Sinaloa. With the aim of colonizing the native tribes, expeditions were sent up the river. These were headed by priests, backed by a strong escort, and their work was to preach their religion and, at the same time, spy out the mineral resources of the region, it being rumored that much gold was to be found in that section.



SAN JOSÉ DE GRACIA

One party, headed by a Spanish captain named Montoya, founded the old town of Sinaloa, building a fort, which he called Fort Sinaloa, in order to protect the party from annihilation by the warlike tribes that populated the river valley, and who called themselves Sinaloas. As this party was small, there being but 25 Spaniards, many attempts were made by the natives to destroy it. Finally they routed the garrison and burned the fort. The remnants of this party made its way north to the Fuerte river, to the town of Tehueco, where, a short time before, another party of missionaries had founded a mission which still exists.

Hardships and Perils of Early Explorations

This exploration was carried on slowly, for the natives made frequent attacks upon the parties, and at times forced them back upon their base at Sinaloa.

In one of these attacks Montoya was killed, which, for a while, put a stop to further explorations by the Sinaloa missionaries. After receiving a new supply of arms and allies, presumedly from Guadalajara, new civilizing campaigns were undertaken, and by 1650 the Chicorato mission was established. Later on the Santa Maria mission was founded.

After many years of assiduous proselyting, the confidence of the native tribes was gained to a certain extent, and the missionaries established a convent and mission at Bacubirito in 1710. Many persons of local note, both ecclesiastical and civil, resided here, though Sinaloa was the mainstay of all these missions. At this time all the Sinaloa missions were under the control of the Durango see and all tithes were sent to that place.

About 1730 there was a general uprising of the native tribes along the Sinaloa river, in which those of the Fuerte Mayo and Yaqui joined. This forced the missionaries to seek refuge in the fortified towns, and thus caused a cessation of mission work for many years. But, finally becoming strong again and reinforced by others from Durango, the missionaries once more bent their energies to civilizing the natives and, incidentally, to exploring the country for precious metals.

The work was reorganized with greater

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enthusiasm than ever before, for it had been learned from passing Sierra Indians that gold was to be found up the river, some of these showing valuable gold nuggets. This fired the ardor of the Spaniards, and the Chicorato and Santa Maria missions were reëstablished. From there the missionaries worked their way up the river to San Ignacio. All these places were lonely Indian villages, isolated in the hills and without local resources for sustaining life.

First Discovery of Gold in 1828

At San Ignacio, today as primitive as when the first Spaniard missionaries stopped there, the Alisos, or San José de Gracia arroyo as it is now called, empties into the Sinaloa river. Up this arroyo the untiring explorers plodded to an Indian village occupying the site of the present mining town of San José de Gracia.

This was in 1828, and the small group of gold-seeking friars, together with a goodly following of so-called tame Indians from the older missions, had without knowing it, after 75 years of following the many vague rumors of wealth in the mountains, arrived at their Mecca.

On the top of a rounded hill in a large arroyo that empties into the Alisos just below San José de Gracia, the explorers found a few Indian huts. The men ran away at sight of the Spaniards, but a few of the women and children remained. The Spaniards spoke to these, asking for the men and explaining that their mission was friendly and peaceful, and that they were looking for precious metals. They got no answer from the women. They then turned their attention to a nearby pen, built of stone and filled with sheep and goats, with the intention of appropriating a few for their own use. What was their surprise to find that the rock of which the pen was built was quartz, and that in much of it gold could be seen at a casual glance. A closer inspection showed that the Indian huts were built on the outcrop of a rich gold-bearing ledge.

Upon this discovery the camp on the main arroyo was made a permanent mission and called San José de Gracia.

First Mine was the Mina Grande

Work was started at once on the ledge and the mine was called Mina Grande, a name it bears to this day. Although this ledge at the surface proved to be a veritable bonanza, the workings are not over 100 ft. deep at present, and, though always owned by some one, it has been held on its past reputation. Once in a while a little work will be done on it with the hope that favorable results may be obtained.

This is the history of the discovery of the camp, and for this data I am indebted to Señor Manuel J. Esquer, of Mocorito, Sinaloa. The common version is that some packers, having camped near the spot en route to the new bonanza camp of Guadalupe y Calvo, while hunting for their mules in the morning on the tops of the nearby hills, noticed that the goat pens were built of quartz, and, upon examining the rock, found it to be rich gold ore.

The fame of San José spread rapidly and in a short time it became a thriving town. In a list of the men who made fortunes in the camp occur the names of Irizar, Olguin, Estrada and Alvarez, all well known Spanish names.

Other Finds Followed Quickly

After the discovery of "Veta Grande," Todos Santos, Carpinteria, Veta Tierra, Los Hilos, Dulces Nombres, La Gloria and Los Muertos were found in rapid succession and within a radius of half a mile.

All these mines were famous for their rich surface bonanzas. Todos Santos is in bonanza ore today, and Los Muertos and La Gloria, under the new name of Rosarito, have produced over $5,000,000 in gold with a 30-stamp mill since 1895. Carpinteria and Veta Tierra have merely been scratched, and in the future are destined to become great mines.

REDUCTION PLANT AND OFFICES, ANGLO-MEXICAN COMPANY, LIMITED

The country is much faulted, with throws of 2 to 50 ft. This phenomenon was not understood in early days, the current belief being that the cutting out of the ore was due to the "cutting in" of a "horse", and the belief became fixed that these gold bonanzas were purely superficial. Therefore when a "horse" cut out the ore work was usually abandoned in that place. For this reason much prospecting was done **and all the ledges** known today were discovered and worked at that time.

The fame of San José de Gracia later became so great that about 1833 the place was assaulted by a large band of Indians, led by Spanish bandits, with the

object of carrying off the gold then accumulated. Considerable booty was secured, but to this day it is not known who headed the attack or what was done with the bullion carried off.

The great bonanza of Guadalupe y Calvo was then in its prime, and the owners, not being able to prevent local stealing, bought all bullion offered for sale as a protection. On this account it is supposed that the gold carried away from San José de Gracia found its way to Guadalupe y Calvo.

Many Left San Jose for California in '49

The discovery of bonanzas at San José de Gracia was constant up to 1849, or for a period of 21 years.

In 1849 most of the claims had been abandoned or had come down to ore of normal grade, and, the glory of California beginning to be heralded generally by the next spring, many caravans were made up that traveled overland via Guaymas and Yuma, meeting untold hardships and dangers. Thus, by the end of 1850, San José de Gracia was practically abandoned.

One of the leading mining men of that time in San José was Don Francisco Peraza, a man of humble birth but great natural ability as a miner. Peraza caught the California fever and spent several years there. The cholera epidemic of 1851-1852 also contributed to the complete suspension of all work, during those years, at this famous gold field.

About this time Don José Manuel Peña settled at San José. He, being a man of more than ordinary sagacity, and being well acquainted with the history of the camp, during this period of stagnation acquired possession of several of those claims which he considered the best as they became open to location, due to abandonment, under the old Spanish law then in force. Upon their return from California a few years later, many of the old mine owners found Señor Peña in possession of the claims they had abandoned, and most of them left the camp.

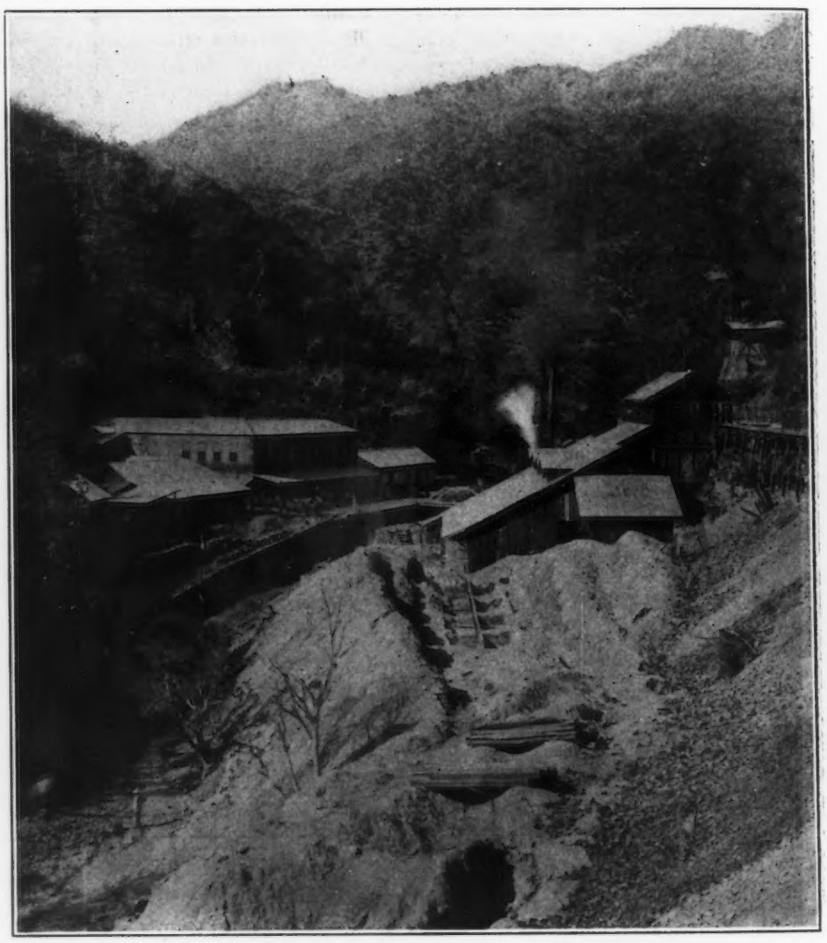
A Renewal of Activity

About 1870 Don Francisco Peraza returned to San José and started work on a new find near the summit northeast of the camp, and in a short time had opened up a small bonanza. He also struck a rich pocket in Santa Rita, another find in the center of the ore zone. He and Sr. Peña worked with indifferent success, and were practically the sole owners of the camp until 1884.

During the years between 1871 and 1877 little was done in the camp on account of constant political revolutions. No one cared to work; for anyone who was thought to have anything was promptly relieved of it by one or, perhaps, by both belligerents. The success of Diaz in 1876 put an end to these conditions the following year, and since then property rights have become more secure every year.

By 1878 Don Francisco Peraza had become possessed of the claims along the Guadalupe ledge for half a mile, under the names of Guadalupe, Muertos and Jesus Maria.

Don Manuel Peña had by this time sifted his holdings down to Todos Santos, Santa Eduwiges, Veta Tierra and La Ceceña. Peña, being a close man and calculating, was very careful, and most of the time did but little work on his properties, letting them out to leasers, and in this way complying with the law in order to hold them.



PIRAMIDE COMPANY'S MILL AND BUNK HOUSES

Rich Pocket in San Judas

Peraza, on the other hand, had faith in the permanency of the camp, and in a small way continued working on Jesus Maria. During this time, being pressed for money and his own claim being barren where he was working, the idea struck him to do a little work on a ledge called San Judas, it being one that had given several rich bunches of ore in the few feet of surface work done. He told me that it took him three days to unwater the old shaft and one to get a new face started. He immediately ran into a bonanza pocket, and in the two days following took out $25,000 in gold. His pocket cutting out, he did no more work there, nor has any more work been done up to this day. However, since that time the Peña family have owned the property.

Peraza worked away on his Jesus Maria claim, running in a small 3x5-ft. drift along the ledge, and managed to just keep the work going.

When his small drift became so hot he could not work he started an air shaft without the aid of a survey, and, after a year or two of zigzagging around, finally made connection near the end of his drift and continued his search for the ore shoot he felt sure existed.

Discovery of Carpinteria Bonanza

In 1888 an Italian and a local Mexican miner started work on a ledge now called Carpinteria, with such good luck that they ran into a bonanza.

Neither, being poor, could stand prosperity, and in a few years both died from excessive debauchery. In the meantime Peña and Peraza had acquired the mine.

First Mill Built in 1887

Up to 1887 all ore taken out of the mines was treated in arrastras run by mule and water power. In that year an American by the name of George Davis took up the Purisima property, the poorest in the Camp, and installed a small Huntington mill run by steam. This venture proved a failure and the mill was later acquired by Peraza and put up on the main arroyo below the town.

Jesus Maria-Guadalupe Bonanza Found 1893

After years of patient work, all too poorly recompensed, in the summer of 1893 Peraza's drift reached the main ore shoot.

Just at this time H. H. Hughes was closing up the old Trigo mine (owned by The Anglo-Mexican Mining Company). good and proved to be about 400 ft. long. The ledge averaged 4 ft. in width and contained about $70 gold per ton, not including the "chispa" (high-grade rock). Much rich ore was encountered, and shipments of 10-ton lots were made from time to time, averaging from $10,000 to $14,000 gold per ton. About the center of this shoot on the level of the Peraza drift, afterward called the Guadalupe level, a winze was sunk on a rich body of ore. This was about 150 ft. deep and it was claimed at the time that the ore that came from the winze paid for the mine.

By June, 1895, Hughes had opened up the mine to the extent of having fully a million dollars blocked out and had a 60-ton milling plant in good running order, together with offices, laboratories, machine shops and all other needed buildings, and had been shipping over $50,000 per month for 6 months.

Mill Heads Averaged $72 for 3 Years

The shipment for June, 1895, was $129,000 gold. The mill heads ran $30 to $300 per ton. So rich was the ore at that time that the average of the mill heads was $72 for three years.

Early in 1895, in raising, a fault was encountered which displaced the ledge more than 30 ft. An air shaft had been run to the surface, and from this shaft, above the fault, crosscuts were run each way.

The one toward the footwall ran into the ledge and rich ore, and when opened up, this proved to be 400 ft. long, averaging over 4 ft. in width and $64 gold per ton. The ore contained about one ounce of silver to the ounce of gold, but the bullion always ran between 700 and 750 fine gold.

By the end of 1895 there were about 30,000 tons of tailings on the dump averaging better than $25 gold per ton, so experiments were started early in 1896 to treat these by cyaniding, under the charge of Henry R. Batcheller.

Discovery of the Great Rosario Bonanza

Less than 2 miles northeast of the Jesus Maria a claim was taken up on the old Los Muertos ledge, under the name of El Rosario, by Don Antonio Echavarria and associates in 1894. This was a large well defined ledge, and a little rich ore had been taken from near the surface in the early days of the camp though the ledge only averaged about $5.

JESUS MARIA MINE, SAN JOSÉ DE GRACIA, SINALOA, MEXICO

at Las Yedras, on the boundary between Sinaloa and Chihuahua, about 50 miles east of San José de Gracia. Hearing that Peraza had struck a body of good ore in the Jesus Maria mine, he sent over and had some samples taken. The face was about 4 ft. wide and the drift extended into the orebody probably 50 ft. These samples ran from $50 to over $400 per ton, and on the strength of this Hughes sent for Peraza and closed a deal with him, buying all Peraza's claims in the Guadalupe group for $75,000 gold and $75,000 Mexican silver, paying $30,000 silver down and the balance in easy payments.

4-ft. Vein Averaged $70 per Ton

Hughes took charge at once for the Anglo-Mexican Company and started to open up the mine, putting W. C. Wilkins in charge. The body of ore continued

Early in 1895 a short crosscut adit was run which tapped the ledge about 100 ft. from the surface and exposed a width of 7 ft. of bonanza ore. So rich was this ore, that by the middle of 1896 they had a 30-stamp mill running with all necessary accessories, all paid for out of the mine. This mine has been a steady producer up to the present time, and for over five years from the start averaged an output of half a million dollars in gold per year.

Location of the Camp

The camp of San José de Gracia is situated in the northeastern part of the district of Sinaloa, state of Sinaloa, Mexico, about 100 miles east of the Southern Pacific Railway station at San Blas, and is almost on the boundary line between Sinaloa and the state of Chihuahua.

The general elevation of the camp is 1200 ft. above sea level, with ranges on all sides rising to 4500 ft.

Geology—Faulting a Feature

The formation at San José de Gracia is andesite and rhyolite. However, the Rosario mine is on a contact of diorite with a silicious slate. The Jesus Maria-Guadalupe vein is entirely in andesite. This is much altered and decomposed. Much faulting has taken place and many of the ledges are faulted both with the strike and dip. A fault of but 8 ft. stopped work on the San Nicolas claim, afterward part of the Guadalupe, and left the main part of the big bonanza to be exploited by the Anglo-Mexican Mining Company in 1895. Had the early miners sunk a little and then crosscut to the hanging-wall, a distance of 10 or 12 ft., none of the upper part of the rich body taken out by the Anglo-Mexican Company would have been left.

There is no regular course to the ledges of the camp as they have all strikes and dips, but the Guadalupe system runs slightly northwest with dip to west, and the Rosario group strikes strongly northeast and dips north west. Between and around these two main groups, ledges run in all directions, no two dipping alike.

Though the faulting is intense, still no signs of dikes are to be seen and the fissuring is probably due to a huge uplift, probably of the rhyolites to the north.

Santo Tomas Sold by Peraza

During the summer of 1895, Don Francisco Peraza went to the City of Mexico to be cured of some chronic internal malady. Although this is said to have been successfully accomplished, the climate of the city was too much for the old gentleman and he died there before he could return home.

In November, 1895, Don Salvador Malo, of Mexico City, appeared at San José de Gracia, having bonded the Santo Tomas group from young Francisco Peraza before leaving Mexico City. Malo was a distinguished looking, well educated and, in a way, brilliant man, but ignorant concerning mining matters. His operations were not successful.

La Purisima Group

Between the Jesus Maria and the Rosario groups lies the Purisima group, occupying a ridge between the Barranca Grande arroyo and the Barranca Chica. Early in 1895 a company was formed in the City of Mexico to work this group. A large amount of money was spent in development and a mill was constructed. The mill ran but a few months when the ore gave out and, though the company spent large sums in trying to find a permanent orebody, it finally had to give up, charging a fortune to experience.

End of the Anglo-Mexican Company

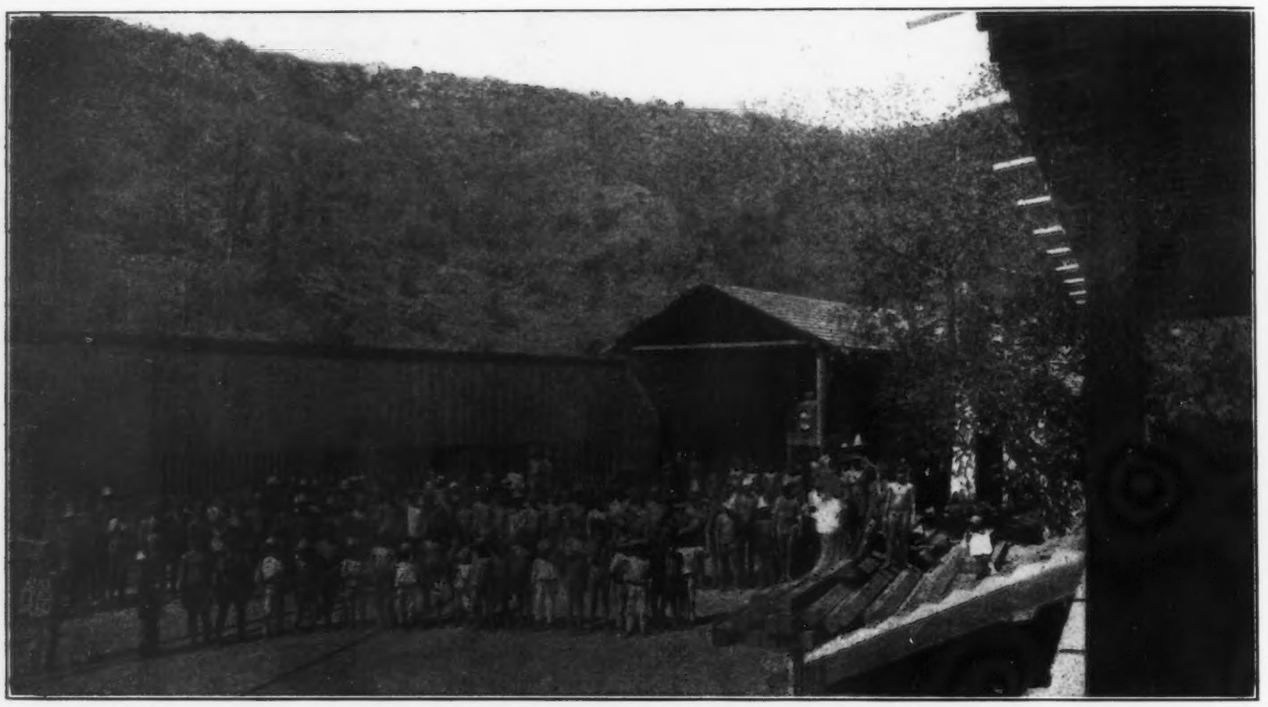
In 1897 the Anglo-Mexican Company bought the Todos Santos property from the Peña estate against the advice of its consulting engineer. Development work along ¾ mile of ledge was carried on until 1900, when the mine and mill were closed down, as the mine had reached a point where more money was needed to open up new bodies of ore than these bodies would produce.

The next 18 months were devoted to treating a pile of slimes by agitation and cyaniding. This was successfully done and the pile cleaned up by April, 1902.

The lowest level in the Guadalupe claim was but 900 ft. below outcrop, with the dip, and 250 ft. was the deepest working on the Todos Santos.

A plan for deeper exploration was submitted, but it was decided to sell out and liquidate the company.

In May, 1902, I sold the property for the company to Messrs. Peraza and Tarriba for a nominal sum. These gentlemen formed the Compañia Minera Jesus Maria y Anexas and gophered the mine until 1904, at which time they found themselves about 130,000 pesos poorer.



MINERS AT THE JESUS MARIA MINE, SAN JOSÉ DE GRACIA

At this time they were fortunate enough to take out a small pillar in which they encountered a bunch of bonanza ore that gave them about 400,000 pesos in 40 days. A description of this find was published in the *Min. and Sci. Press*, June, 1906—that for the first week, I believe.

Success of the Anglo-American Company

In the winter of 1905-6 the writer was employed to study a plan of development work, and the plans submitted to the Anglo-Mexican Company were carried out, though, in justice to Norman Tracy, who was the manager at the time, it

must be stated that he had already decided upon the same system and had started a preliminary survey with the idea of laying out the adit that was eventually run. This work involved a crosscut of about 500 m. and a drift of 1000 more, and was run for the purpose of tapping three of the known ore shoots.

Where this adit cut the ledge it was found to be of high-grade ore and the mine has been in bonanza ever since, or about three years.

The Peraza in the new company, is Don Francisco Peraza Martinez, the only son of old Don Francisco Peraza who fought hard luck for so many years at San José and finally sold to the Anglo-Mexican Company. The fortune left him by his parents, young Peraza has, by judicious investments and a continuous streak of good fortune, greatly enhanced and today he is one of the wealthy men

ENTRANCE TO TUNNEL, ANGLO-AMERICAN COMPANY, LIMITED

of the state. Both he and the Messrs Tarriba are interested in the Rosario, the other bonanza mine of the camp.

In spite of 90 years' almost continuous production this camp is practically virgin as the deepest workings are barely 700 ft. vertically below the surface. There are probably 50 known ledges within a radius of 1½ miles, many of which have given one or more bonanza bunches at surface.

Now that the railroad has made this section accessible to the world, although there is still a wagon and pack haul of 75 miles, in a few years more we should see twenty producing mines instead of two.

The new Guerrero mill of the Real del Monte y Pachuca Company, at Pachuca, Mexico, uses 1050-lb. stamps, dropping 106 times a minute through 7 inches.

Oxidation and Cyanidation

By Hubert A. Megraw*

One of the most important reactions in the field of treatment by cyanidation, is that of oxidation. In the very beginning of work with cyanide solutions it was recognized that oxygen, according to Elsner's equation, was a necessary element in the solution of gold. Elsner's equation was made the object of frequent attacks by metallurgical chemists, but it outlived all the criticisms and is still recognized as a true expression of the operation of dissolving gold in cyanide solutions.

In view of this fact there have been many attempts to introduce oxygen into working solutions, largely by the use of oxidizing agents consisting of chemicals. Probably one of the first to be used in this way was BaO_2. Some measure of success followed the use of these agents, but it has finally come to be the general opinion that air itself is the cheapest and best oxidizing agent to be had.

Oxidation More Difficult with Silver

With gold, results which are satisfactory and prompt have been accomplished. In working with silver, however, the complications multiply and the point of satisfactory results has not yet been reached. The volume of silver in a commercially economical ore is so great, compared with a gold ore of equal value, and the reactions so much involved, that a much longer time of treatment has come to be considered proper and necessary. While oxygen does not play the direct part in the dissolving of silver, as in gold, it is no less necessary.

It is admitted that oxygen is necessary in dissolving silver and a glance at the reactions involved will show that a good deal of it is necessary. In the treatment of silver sulphides, of which by far the larger portion of treatable silver ores consist, the lead acetate necessary for removing soluble sulphides from solution, is responsible for a large part of the consumption of oxygen. The following reactions, suggested by Caldecott (*Journ. Chem. Met. and Min. Soc. of South Africa, March, 1908*), show the different steps in the process and illustrate the function of oxygen:

$$2\ Na_2S + 2\ O = Na_2SO_3 + NaO,$$

$$Na_2S_2O_3 + Na_2O + 2\ O = 2\ Na_2\ SO_4,$$

$$Na_2S + NaCN + O = NaCNS + Na_2O,$$

$$Na_2S + PbO = PbS + Na_2O,$$

$$PbS + NaCN + O = NaCNS + PbO.$$

These reactions illustrate the use of oxygen at every stage of treatment.

Numerous experiments made by metallurgists in close touch with the actual operation of the process, all seem to point in the same direction. A series of experiments published by Caldecott (*Min. and Sci. Press,* Aug. 29, 1908) gives the comparative results of the treatment of a silver-gold ore by a good many different chemical combinations. From this series it was found that the best results in the case of the gold came from the use of BaO_2, having accomplished an extraction of 89.7 per cent. in six hours using 0.1 per cent. of the chemical. In the case of silver the best results were obtained by the use of oxygen under 100 lb. pressure. In this case an extraction of 79.4 per cent. was accomplished in the same time.

Utilization of Free Air

The theory that a sufficient quantity of oxygen for the completion of the necessary reactions will permit of treatment in a shorter time than is now allowed, is very attractive. Free air is not a particularly active oxidizing agent, and it is upon this that silver treatment rests almost entirely at present. Air under pressure is more active and better results can be obtained by its use. A series of experiments made with these facts in mind seems to show this clearly.

The accompanying diagram shows the plotted results obtained under identical conditions, except that the curve *a* shows the result of treatment by agitation and oxidation by free air alone, *b* shows the result of circulation with a centrifugal pump after 48 hours of treatment by free air agitation, and *c* shows the result of the use of the centrifugal pump alone during the entire time of treatment.

The experiments were made on slime charges in round, flat-bottom tanks, the air agitation being accomplished by introducing air from a compressor through a number of jets fixed in the bottom of the tank and, in addition, an air pipe introduced into the charge and handled by an operator in order to reach parts of the tank upon which the jets did not have a thorough effect. The centrifugal pump used had a gland loosely packed in order that air might be drawn in during the pumping, the idea being that even this small amount of air under light pressure is advantageous.

Experiments along the line of oxidation have been made during the last two years. Some of the results are given in an accompanying table as averages. The amount of oxidizing agent used was calculated to furnish an amount of oxygen equal to 10 per cent. of the weight of silver contained in the ore. A short time of treatment and low grade of ore was used in order to show any differences in results as sharply as possible.

Comparison of these results seems to show that the use of oxygen does have a definite effect upon the rate of solution of silver.

Oxidation by Chemicals Not Practical

After making a long series of experiments the conclusion is reached that the

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use of chemicals as oxidizing agents is not likely to become common practice, nor is it advisable because of the expense and also because of the introduction into solutions of other and useless chemicals, further complicating the already sufficiently complex solutions. The idea that oxidation is beneficial, however, is so undoubtedly true that it is very desirable to evolve some method of supplying oxygen for the prompt completion of the reactions. In the work of Julian and Smart, "Cyaniding Gold and Silver Ores," a good deal of attention is given to the subject of oxidation and a number of experimental results are given. Quoting from page 75:

"It is obvious.....that it would not be economical to apply strong oxidizers to an ore direct, as, owing to the rapidity of the reaction, the effect lasts too short a time to facilitate the dissolution of the gold to any extent.....The only case in which strong oxidizers can be of benefit, when applied to an ore direct, is where the gold is in an extremely fine state of division and can dissolve rapidly as in the treatment of slime by agitation."

In the same chapter we have:

"It is therefore advisable when employing oxidizers, to select one which introduces only oxygen, or oxygen and water. The more energetic oxidizer as $KMnO_4$, Na_2O_2 etc., oxidize cyanide to cyanate and facilitate the formation of some complex compounds, but in very dilute solutions this action is not marked." It might be added to these statements, that in treating silver slimes, the addition of the oxygen should be made at about the rate at which it can be consumed in the carrying out of the reactions. A chemical which delivers all its oxygen is not an advantage, but rather a harmful influence, as that oxygen not used by the reactions is likely to operate upon the cyanide solution itself.

Recommends Oxygen Derived from Water

Authorities seem united as to the advantages of oxidation in some form. Since the formulation of this paper, an article in the *Min. and Sci. Press*, May 15, 1909, by D. Mosher, has set forth much the same facts as herein stated. Mr. Mosher gives a list of experiments with different oxidizing agents and also notes the comparative costs of each. Mr. Mosher, however, has suggested a form of oxidation which differs slightly from that which it was the purpose of this paper to advocate.

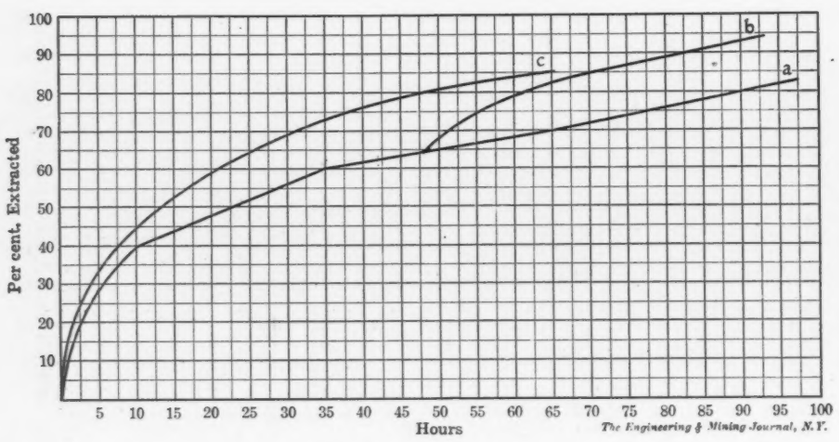
I had devised a method of deriving oxygen electrolytically from water and adding it in a fine stream to the slime pulp under treatment. The cost of this system would not be great and its application especially simple. It is necessary only to introduce a small pipe leading from the oxygen tank into the suction of the centrifugal pump used for circulation, or into the air lift in case the Brown tank is used. By means of a valve, the amount of oxygen used can be definitely regulated and the speed of its admission made to conform to the speed of the reactions.

Mr. Mosher recommends the use of ozone from air, and while this might be used in the same way and accomplish the same results, I can make no comparison of costs at present. It seems that the oxygen from water might be produced at least as cheaply as from air, and it certainly would introduce no extraneous elements into the solution. The comparative merits of each method may be determined only by experiment, and possibly location and advantages in other ways may have some effect upon the cost. The oxygen from water requires no expensive apparatus to generate it, and a small current would be ample for ordinary plants.

The question of oxidation presents some interesting features in that its successful use may show the way toward shortening the time of treatment of silver slimes, thus reducing the cost of treatment materially. It is hoped that metallurgists having the necessary facilities will give some attention to the matter for the ultimate good of the profession. The writer is working on the scheme and hopes in time to have other interesting results to offer.

TABLE OF EXTRACTION OF SILVER WITH VARIOUS OXIDIZING AGENTS.

Heads. Gm. Ag.	Solution, KCN. Per Cent.	Ox. Agent.	Time Treated, Hours.	Tails. Gm. Ag.	Extracted. Per Cent.
143	0.1	none	24	62	56.5
143	0.1	$KMnO_4$	24	42	70.6
143	0.1	H_2O_2	24	40	72.1
143	0.1	$Ca(OCl)_2$	24	38	74.4



History of La Luz Camp, Guanajuato, Mexico

It was on the La Luz group of veins that the first discovery of silver and gold in the Guanajuato district was made as early as 1548. The legend is that in that year, a pack train while on its way from the coast to the already known mining camp of Zacatecas camped one night at a point which is now the entrance of the Bernabe tunnel on the old La Luz mine. The camp fires, built on what proved to be the outcrop of the La Luz vein, melted out some of the silver. The news soon spread and attracted hordes of prospectors. Soon other deposits were discovered, and about 10 years later the celebrated Veta Madre of Guanajuato was opened upon. The enormous bonanzas of the Valenciana and Rayas, on the Veta Madre, threw into shadow the more moderate riches of the La Luz district, which remained practically undeveloped until about the year 1832. In this year, Count Perez Galvez, the chief proprietor of the Mother Vein mines leased all those to some English companies, and then turned his attention to this new field. A tunnel had been started, nearly three centuries previous, at the point of discovery, by the original workers. This tunnel was cleaned out and pushed forward along the vein for a distance of over 4000 ft., and from the appearances at the present time the whole length was driven in what today is profitable ore. It was, however, only about 10 years later that the tunnel reached the rich bonanza orebodies, which since that date—1842—have yielded according to all the most reliable data available, not less than $130,000,000. When the value of this discovery was understood, active work on a large scale was commenced, and 12 working shafts of large size and of depths now reaching from 600 to 1400 ft. were started. Most of the shafts are today in good condition.

A Hot-blast Furnace for the Small Operator

Continuous Runs Are Possible; Can Be Used without Choking or Freezing; Low Labor Cost; Recovery of over 90 Per Cent. Secured

BY PERCY ANDRUS BABB*

Of inestimable benefit to the mining men of the Republic of Mexico would be a smelting furnace, practical in small capacities, built for rough mountain transportation, and in price within the reach of the prospector and small operator. Such I believe the New Model hot-blast furnace may be.

Dry ores in isolated camps are readily treated by familiar reduction processes and their final and concentrated products of bullion, rich precipitates or high-grade concentrates will stand high freight charges, but not so at the small lead or copper prospect. A medium-grade lead property, unless it should be most materially assisted by accompanying precious metals, is not an attractive venture under the present commercial conditions of this metal. Such a property, and even one of low grade, may well have an altogether different aspect if it be feasible to roughly dress and then smelt the ores, thus concentrating the metallic content into bars and a relatively small amount of matte containing together about 90 per cent. of the lead and 90 to 95 per cent. of the silver and gold.

Demand for Small Furnaces

Eliminating geologically and geographically the "Central Plateau" of the Republic, throughout which copper properties generally are happily situated with reference to the custom smelters and railroads, and whose ores possess good fluxing qualities through immediate contact or close relation with limestone, we find in the Cordillera Oriental, and still more so in the Cordillera Occidental, that the copper miner is encompassed with difficulties. Here the ores occur in acid eruptive rocks and, therefore, assay high in insoluble material; the copper usually occurs in the form of chalcopyrite and, although conditions may be ideal for concentration, the final product will hardly carry over 20 to 25 per cent. copper; long broken mountain trails lead to the railroad, and then an additional freight charge must be paid before the shipment is even on the trunk line. On the other hand, if limestone is to be had, as usually is the case, a proper sorting of the ore or perhaps a simple jigging will so bring up the copper and iron and at the same time so reduce the acid content that an easy-smelting and well-fluxed material will be secured for reduction in the blast furnace. By resmelting the first-grade a matte carrying 50 per cent. copper and able to pay its way to the market can be turned out.

STANDARD SIZES OF THE NEW MODEL HOT BLAST FURNACE.

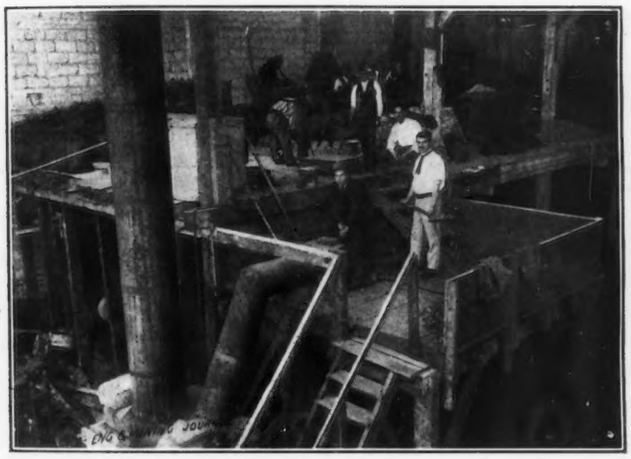
Diameter of Wind Space.	Capacity per 24 Hrs.	Shipping Weight.	Power Required.
In.	Tons.	Kgs.	H.P.
10	5	2000	1½
14	10	3000	2½
17	15	4000	4
20	20	4500	5
22	25	5000	6
24	30	6000	10
28	40	7000	20
31	50	8000	25

An accompanying table gives the standard sizes of the New Model hot-blast furnace, but my experience with the 10-in. or 5-ton size leads me to believe these capacities will be found to be over-estimated; personally, I would be disposed to figure on 10 per cent., and on very "dry" low-grade copper ores even 20 per cent. less than the capacities given in the accompanying table.

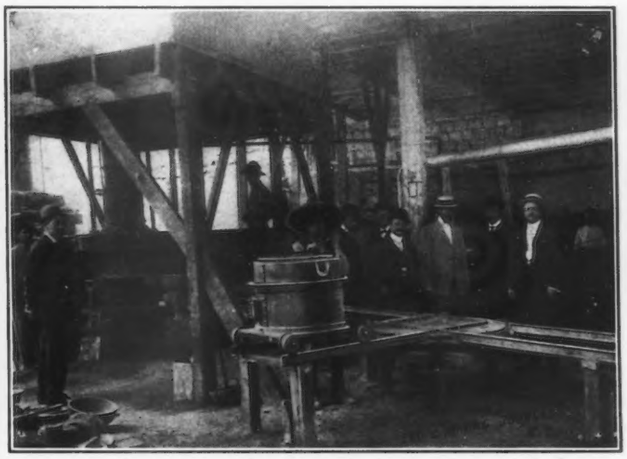
Tuyeres Dispensed With

No startling innovations are encountered in these furnaces, nor is radical change necessary from the usual blast-furnace practice. The customary water-jacket vertical stack with bosh, the fire-brick lined crucible with slag and matte taps, air under blast entering the stack at the fusion zone, the feeding of the charge into the top of the stack, the separation through gravity of the slag and the matte or metal in the crucible—all are as we have witnessed many a time before. There are to be noted, however, certain salient improvements which assist greatly in the smooth running of the furnace, reduce the fuel consumption, and make possible uninterrupted campaigns in capacities of 5, 10 and 15 tons per 24 hours. This latter, to my knowledge, has never before been accomplished. Again, the circumstance that such a furnace, which will actually produce results, can be placed aboard cars in a couple of months' time, is manufactured in Mexico City where it can be seen in operation and changes in construction personally supervised, and is designed for mountain trails, tends to let us view the promising, but isolated lead or copper prospect with more *cariño*.

The real and essential novelty connected with the furnace is a clever improvement to provide for delivering the blast to the stack. The usual tuyere box projects



GENERAL VIEW OF FEED-FLOOR ARRANGEMENTS



TAPPING FLOOR, SHOWING AUXILIARY CRUCIBLE

*Mining engineer, Mexico City, Mex.

from the stack, but it is called the "wind box" inasmuch as the tuyeres have been dispensed with, and in their stead there is a continuous opening of an inch or two in hight forming the blast way into the stack and located, of course, between the crucible and stack. The crucible during operations is set into the wind box and extends to within the above inch or two of the stack. Its top defines the lower boundary of the wind space, the upper boundary being the bottom of the stack. This continuous wind space is a pronounced advantage over individual tuyeres, at least, in furnaces of smaller capacities, and it is by virtue of the same (doubtless assisted somewhat by the hot dry blast) that it is feasible to operate continuously with stacks of capacities of 5, 10, 15, etc., tons per 24 hours.

No Chilling of Slag

The chilling in furnaces of small capacities usually starts between the tuyeres where it is so awkward to bar away accumulations that in spite of all a "freeze down" is inevitable. Who has not seen this occur in the demonstrating stack of the University metallurgical laboratory, and, in a vigorous but futile effort to save the furnace, gotten an acquaintance with muscular metallurgy? In my experience with the 5-ton furnace not once did chilled slag choke up this opening, nor on the other hand was there an overflow of slag into the wind box. "Peep-holes" of a diameter to accommodate a bar are conveniently placed about the wind box, and should any noses form in this region they can easily be barred away. Having in mind furnaces of large capacities, i.e., 100 tons and more, it has been wondered if the greatly increased amount of slag might not occasionally overflow through the wind space and bring disaster upon the "run." I fail to see why an overflow of slag in this type of furnace need wreck a campaign any more than in the case of a rising of the slag into the tuyeres of the standard furnace; surely the wind box opening directly into the stack through the wind space offers an escape to any overflow of slag that is not open in tuyeres.

An ingenious and logical method, hardly new in principle to metallurgists, is introduced for heating the blast. The slag overflows into a brick-lined chamber (wind tunnel) at the opposite end of which the blast enters and passes along the chamber above, and in contact with, the molten slag, thus becoming heated and entering the stack as hot blast. Small overlapping cars receive the stream of slag from the tap, the cars traveling on an endless track toward the blast end of the chamber or tunnel. The cars with their burden of slag spill the slag into cool water on making their turn for the back trip, causing it to granulate and fall off. An elevator picks up the slag at the bottom of the well of water and delivers it on the outside of the tunnel where it is dumped. The well of water furnishes a medium for removing the slag to the outside without leaving any escape for the blast except through the stack.

Crucibles Quickly Changed

The crucible is separate from the stack, is easily and quickly detached by lowering a jack, and is interchangeable with an auxiliary crucible kept on hand warmed for use. This is certainly a great convenience should a furnace be lost, as in half an hour the stack can be cleaned of any foul charges, the auxiliary crucible set up and operations resumed. In an hour and a half the ore charge will again be down to the slag tap. A short track, 15 to 20 ft. long, extends from directly under the stack to a turntable and spur track where the auxiliary crucible, already warmed for a case of emergency, awaits on trucks. This arrangement is a departure from the usual relation of the crucible and stack, and is to be recommended on small furnaces; but it is not altogether new as it has been employed in the Northwest on oblong furnaces of large capacities.

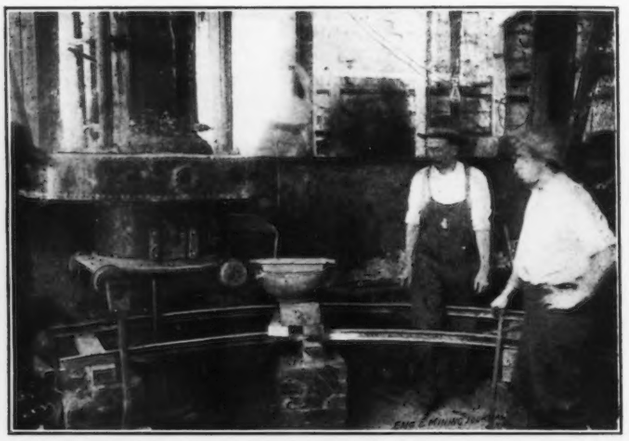
The hot dry blast and the continuous wind space give to the furnace an excellent driving power once it is well under way. In order to obtain a good separation in the crucible and produce clean slags, reasonable care should be taken to make up a properly fluxed charge and to feed it uniformly. One good point about the furnace is its ability to recover from the results of an error in feeding or an oversight or neglect on the tapping floor, and this applies to even the 5-ton furnace; but naturally mistakes here as in standard furnaces involve a dropping off of the driving rate of smelting and require a few charges of slag with perhaps extra fuel to warm up and clean out rebellious or chilled accumulations in the stack.

High-silica Slags Possible

Slags of higher silica than good practice in the standard furnaces requires have been successfully made in the New Model hot-blast furnace without any bad results in the separation in the crucible, or any material increase in the fuel. With the ore on which a run herewith reported was made, slags were tried carrying 44.2 per cent. insoluble, and the lime reduced to 10 per cent.; yet the furnace ran smoothly, but a trifle slower, and the slags were clean. Experiments are to be made on still higher-silica slags using 10 per cent. coke fuel and charcoal sufficient to give a good fuse to the charge.

To be sure, 13⅓ per cent. of coke was added in the run considered, yet on the same ore the furnace has successfully smelted on as low as 6 per cent. coke and 4 per cent. charcoal. This is certainly remarkable, as the ore carries but 1⅓ per cent. sulphur. Extensive experiments are to be made having in mind the elements which can be utilized along the Cordilleras, such as an abundance of excellent wood for charcoal, but an expensive mule-carry to add to the cost of coke. The purpose is to learn how small a percentage of coke can be successfully employed when combined with different proportions of charcoal, and even with squares of hard wood dressed with lime to hold back their combustion. Some work has already been done along these lines, and it is safe

GENERAL VIEW OF TAPPING FLOOR



MATTE TAPPING IN PROGRESS

to state that the operator is going to reduce his coke to under 10 per cent. on copper ores and considerably less on lead ores. This reduction of coke is doubtless going to curtail somewhat the capacity of the furnace, yet this is a sacrifice of little importance, as instead of purchasing a furnace, for instance, of 10 tons capacity, a size larger would be the choice at but a small difference in cost.

Results of Test Run

An experimental run was made before me on copper-carbonate ores from the Eldorado mine at Amatlan de Cañas. No care had been given in sorting the ore for smelting, but only to bring up the copper. The ore assayed as follows: Gold, 5.5 gm.; silver, 530 gm.; copper, 9.6 per cent.; insoluble, 59.7; FeO, 16.7; CaO, 0.6; sulphur, 1.33. The necessary amount of lime and iron was added in the form of a pure limestone and scrap iron, making a slag that would smelt easily. The coke gave 14.7 per cent. ash in which was 6.6 per cent. silica. The smelting mixture of ore, iron, lime and a little slag, gave a charge assaying 2.86 gm. gold, 292 gm. silver, 4.94 per cent. copper, 37.7 insoluble, 32.5 FeO, and 13.8 CaO. To this was added 13⅓ per cent. by weight of coke.

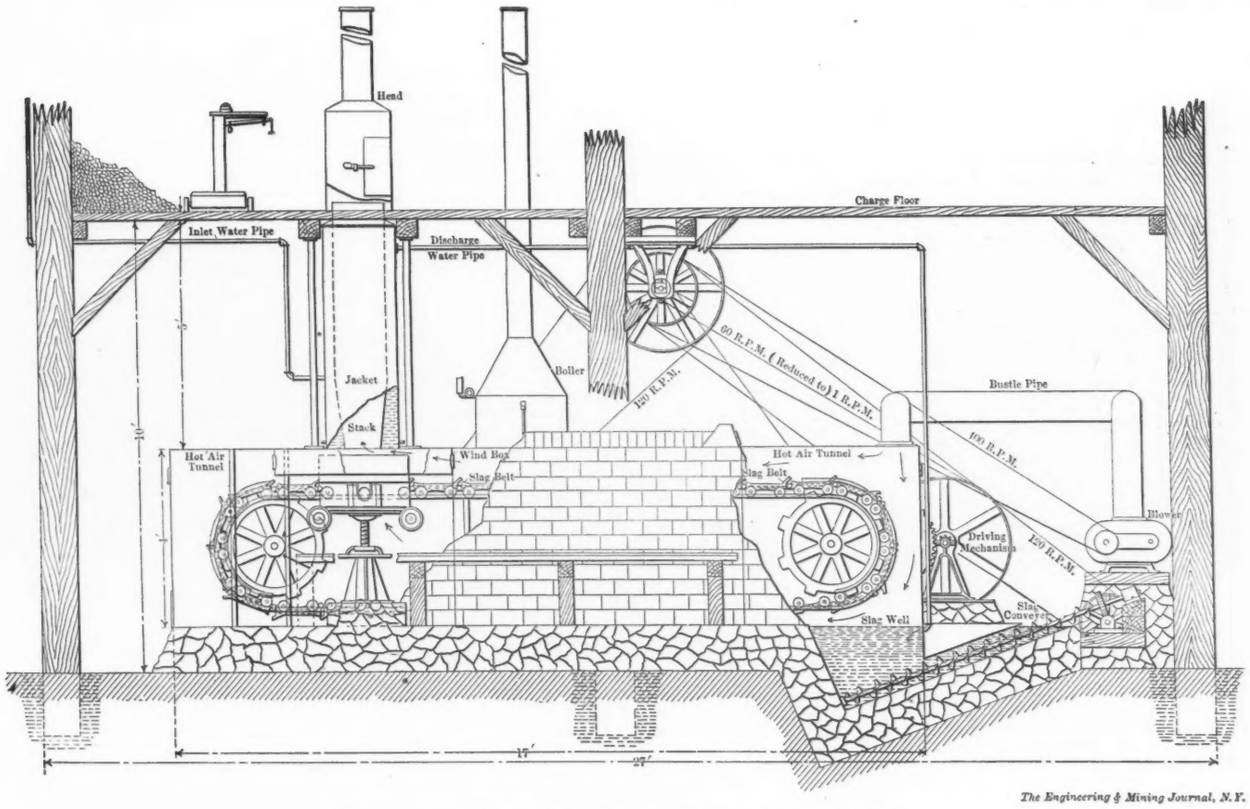
The charges were fed approximately of 60 kg. each. The rate of smelting in periods of four hours was: First four hours, 450 kg. of charge; second, 580; third, 480; fourth, 829; fifth, 760; sixth, 809; total, 3908 kg. of charge. The dropping off during the third period was due to a laborer feeding a few charges containing zinc shavings, which through rank ignorance was supposed to be iron shavings. The total weight of coke was 521 kg. The labor necessary per 12-hour shift consists of one furnaceman, one assistant furnaceman, one feeder and one supplier. In addition to this operating force there should be included an intelligent technical man capable of calculating smelter charges, assay slags and products, and making repairs and adjustments to the plant.

A No. ½ Root Standard blower produced the blast. A No. 4 Acme blower would have been large enough, and is the size recommended with a stack of 5 tons, the dimension of that in which this run was made. The blower ran at the rate of 360 r.p.m., receiving 1½ cu.ft. of free air per revolution. The water jacket received 1 cu.m. of water per hour, and no attempt was made to save it; thus about 24 cu.m. of water were actually consumed. In places where water is scarce 25 per cent. of the above amount of water would be sufficient for a 5-ton plant.

Large Radiation of Heat at Test

A full benefit of the hot blast was not secured, as the capacity of the furnace is such that it falls just short of providing a continuous stream of slag to the wind chamber; only about 75 per cent. of the time the slag was running. Due to this the furnace must have been slightly held back through the temperature of the air not being evenly maintained. Then again, the wind chamber was not lined inside with brick, as it should be, and on the outside for only a foot or so above the floor; thus, the top of this sheet-iron chamber radiated heat at such a rate that at no time could the hand be held on the upper part of the chamber.

While on this same ore I have seen slags carrying but 30 gm. silver and 0.3 per cent. copper, yet the average of the run was 45 gm. silver and 0.38 per cent. copper. The slag contained 39.6 per cent. of insoluble, 34.4 of FeO, and 14.6 of CaO. A product was obtained of (1) 170 kg. of matte assaying 55 per cent. copper, 34¼ gm. gold, 2859 gm. silver, 18.4 per cent. Fe and 21.2 per cent. sulphur to the ton; and (2) 100 kg. of metal assaying 83.55 per cent. copper, 50 gm. gold and 4900 gm. silver. A recovery in matte and metal was realized at 96 per cent. of the gold, 85.5 per cent. of the silver and 91.7 per cent. of the copper.



The Engineering & Mining Journal, N.Y.

ELEVATION SHOWING ARRANGEMENTS OF HOT-BLAST SMELTERY

Sorting and Jigging Advised

It is interesting to note that only 1954 kg. of actual ore figured in the 3908 kg. of charge. Among the ranges scrap iron cannot be had for flux, and its price by purchase would be prohibitive; nor is it to be expected that a practically pure limestone is near at hand. Therefore I would make the point already indicated in the early part of this paper, that it will be found profitable to carefully sort oxi-

dized copper ores, and to the sulphides give a simple jigging. In this way perhaps no iron at all will be necessary as flux, and considerably less barren lime will suffice. In adding any small amount of iron which may be lacking, usually oxidized iron minerals can be found carrying some gold or silver, which very likely will cover the cost of the fuel represented by the weight of the iron flux and the cost of placing it on the feed floor.

A plan of a 5-ton furnace is shown herewith. Neither space nor time has been taken up in describing completely the construction of the furnace, as this plan with the description of the modifications encountered in the furnace was thought to adequately cover the purpose of the paper. I believe the furnace will fill a long-felt want in certain sections of the country, and I have in mind particularly the western parts of the states of Jalisco, Michoacan, Guerrero, Sinaloa, Colima, T. of Tepic, etc. There is no reason why the furnace should not in some cases be an economical investment for properties located along the national and central lines. The gain, as compared to marketing through the custom smelters, is practically nothing for properties directly adjacent to the railroad. On properties more remote it closely corresponds to the cost of the freight on the silica in the ore from any particular property to the custom smelter. To many operators in the Cordillera Oriental y Occidental, the New Model hot-blast furnace promises to satisfactorily solve their problem.

Loreto Mine and the Pinguico District, Guanajuato

By C. W. Botsford*

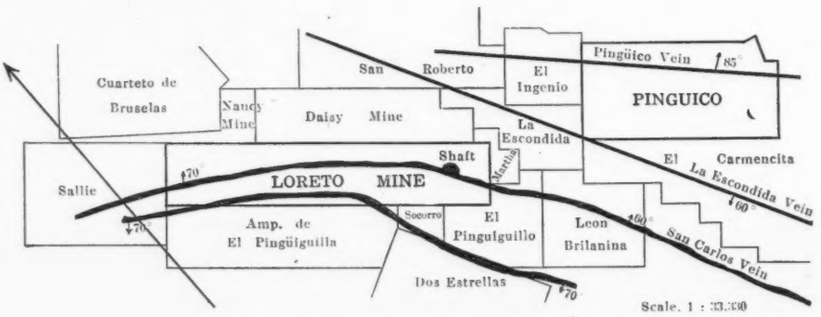
The Loreto mine is situated in the Pinguico district of the Guanajuato camp, Mex., about 1000 m. to the west of the Pinguico mine. The shaft on the property was down about 40 m. on the dip on the San Carlos vein at the time of my visit, and was equipped for prospecting with a horse whim and buckets. By building a short piece of road, the mine can be very easily and cheaply connected with the main wagon road and railroad now under construction. The Loreto contains 48 pertenencias, or 118.5 acres of territory.

Orebodies of the District

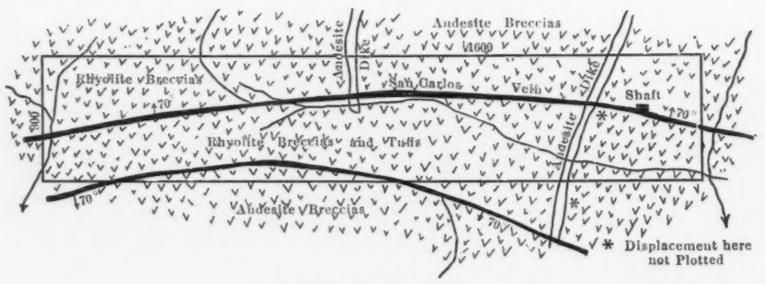
This Pinguico district is peculiar in that the veins do not outcrop. This is due to some extent to leaching, but mainly to the fact that the mineral-bearing solutions did not make ore above a certain level, although traces and an occasional fair assay can be obtained above this elevation. This is probably due to the decrease of heat and pressure rendering the solutions incapable of replacing the country rock. It is, therefore, evident that conclusions regarding the unexplored properties must be largely based on the geological conditions and similarities between them and the known conditions as proven at the Pinguico and Carmen mines which have been developed.

The Pinguico vein is in a fault-fissure zone and during the faulting its walls were much broken up. The faulting was followed by the ascending mineral-bearing solutions which replaced the broken and fissued country rock, depositing at the same time the gold and silver. The orebodies lie entirely in rhyolitic breccias and tuffs. The overlying andestic breccias seem to have been an unfavorable rock for replacment and ore deposition.

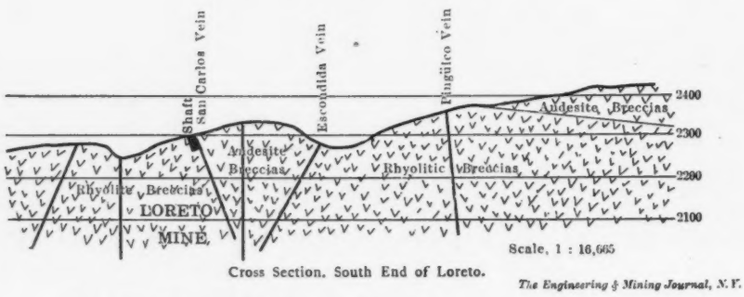
*Mining geologist, Guanajuato, Mexico.



General Plan of District.



Geological Plan - Loreto Mine.



Cross Section, South End of Loreto.

The Engineering & Mining Journal, N.Y.

PLAN AND SECTION SHOWING CONDITIONS AT LORETO MINE

Geological Conditions at the Loreto

Conditions on the Loreto are precisely similar to those at the Pinguico. There is a well-marked vein fault crossing the entire length of the property, 1600 m. This is called farther south the San Carlos vein and is a fault fissure of approximately 200 m. throw. It has a dip of 70 deg. to the east, as shown on the accompanying plan and section. This is the principal vein of the property and is the one upon which the shaft was sinking at the time of my examination. It is easily traceable for about 3 km., as the fault has made it the contact between the andesites and rhyolites. These rocks show by their cracking and fissuring near the principal fault the presence of crushed areas similar to those of the Pinguico vein. Also in the shaft, the contact shows a large amount of brecciation and ground-up rock or mud gouge similar to the Pinguico mud ores.

At the Loreto mine as at the Pinguico are found the large well-defined fault-fissure crossing the property, the well-marked crushed zone along this fissure, and also the presence of small amounts of gold and silver, proving the former presence and action of mineral-bearing solutions. It does not seem reasonable to assume that the orebodies of the Pinguico are the only ones in this district and therefore I consider that, with careful attention to surface indications and by sinking on the most promising crushed zones, new orebodies are likely to be encountered.

Operations of Guanajuato Development Co.

Cyaniding of Concentrates Being Tried with a View to Eliminating Smelting Charges. Peregrina and Pinguico Important Subsidiary Properties

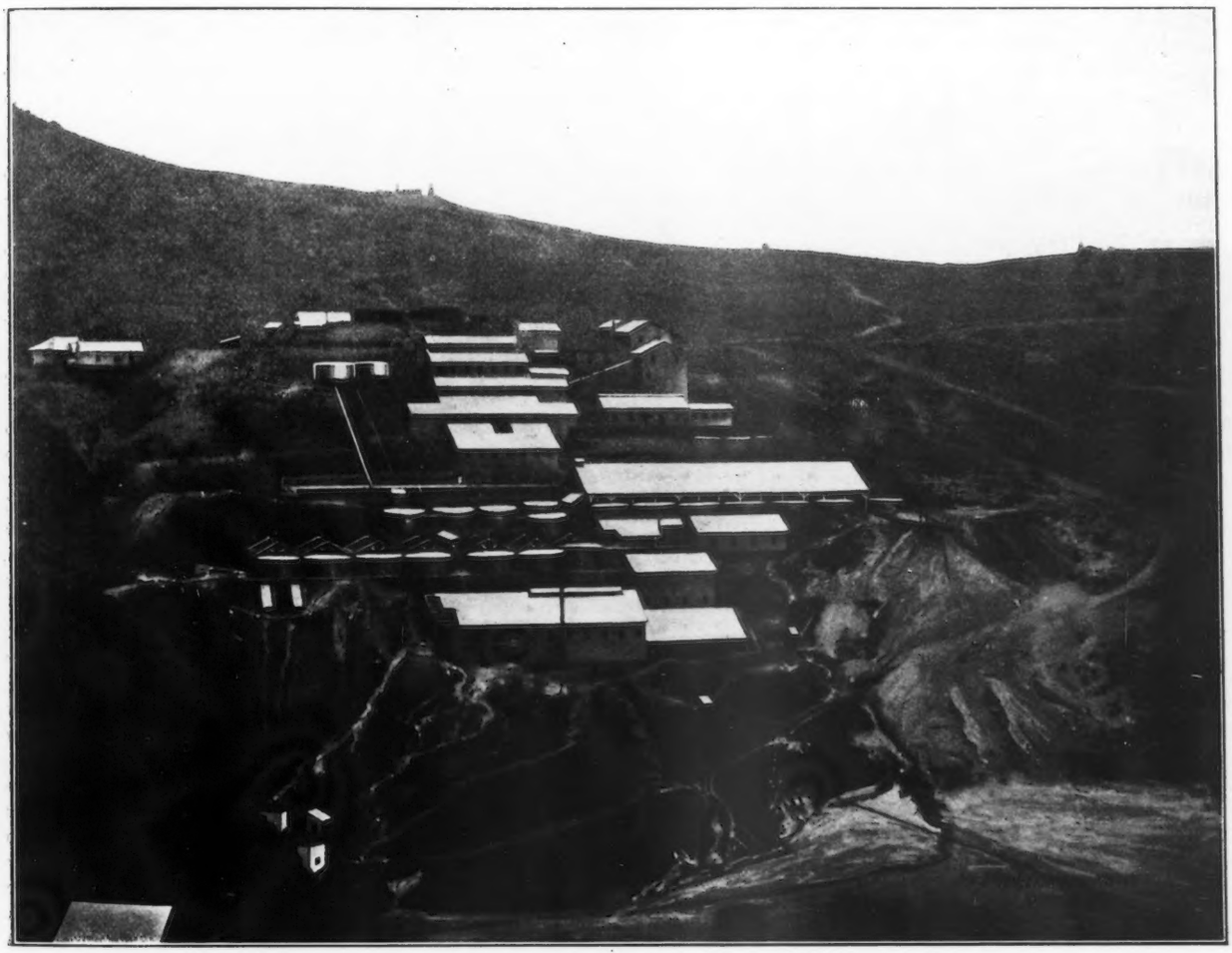
FALL IN SILVER REDUCED REVENUE

The Guanajuato Development Company was organized in February, 1906, to supplement the operations of the Securities Corporation, Ltd., of New York, by acquiring, developing and operating mining and other properties in Mexico. Its operations have thus far been confined to the state of Guanajuato and the principal subsidiary properties at the present time are: The Pinguico Mines Company, operating the Pinguico mine and mill; Peregrina Mining and Milling Company, operating the Peregrina mine and mill; Mexican Milling and Transportation Company, planned to construct and operate a belt-line railroad and large custom mill (this company at present owns two small mills, one of which it is operating); San Isidro ranch, with important water rights giving an adequate supply for milling purposes as well as for the irrigation of ranch lands; La Central group and mill and El Cedro mine are also among the subsidiary properties of the Guanajuato Development Company, all of which will be described in further detail in this report.

Revenue and Profits

Under the conditions prevailing last year it was hardly to be expected that the Guanajuato Development Company could show large earnings, especially as the abnormally low price of silver prevented the subsidiary companies from paying back the monies loaned them by this company. Had the price of silver for the year remained at the average for 1907, the increased profits of the Peregrina and Pinguico companies alone would have amounted to $536,278, which would have nearly extinguished their debt to the Development company and this money would have been available for legitimate business extensions and earnings.

The revenue from operations during the period from May, 1908, to April 30, 1909, was $1,155,013. Operating expenses for the same period were $1,084,955, leaving a profit for the year of $70,054. The receipts from other sources were $137,160, which added to the net operating profit totals $207,217. Deducting the dividend of $60,000 paid during the year, there remains a surplus of $147,217; property, tools, supplies, etc., were depreciated $25,963, leaving a net surplus of $121,254. Previous to April 30, 1908, the company earned, over and above all expenses and dividends, the sum of $342,484, which



CYANIDE MILL OF THE PINGUICO MINES COMPANY AT GUANAJUATO, MEX.

added to the surplus for the present period, makes the total surplus to date $463,738. In addition to this there is in the treasury of the company a stock profit in securities of other companies amounting at par value to $6,097,666. All dividends accruing on the preferred stock since the organization of the Development company, amounting to $154,365, have been paid.

Cyanidation of Concentrates

The treatment of concentrates from the Guanajuato mills has been under consideration for several years. Early in 1908, J. B. Empson, a cyanide metallurgist, was engaged to conduct a series of tests on the concentrates from the mills of the subsidiary companies. These tests indicated that a high extraction of the gold and silver content, viz., 98.5 to 99.5 per cent., might be obtained. Following these experiments a small plant was erected at the San Prospero mill of the Mexican Milling and Transportation Company to treat these concentrates, limiting the construction expense as much as possible until practical success on a working scale was demonstrated.

Previously all the concentrates from the mills were sold to the smelting company at Aguascalientes, and were subject to a freight and treatment charge of $24.95 per ton, in addition to deduction from the gross assay value of the shipments, the smelting company paying for only 95.7 per cent. of the gold and silver contained. At the present time the mills operated by the Guanajuato Development Company are producing about 150 tons of concentrates per month, having a gross assay value of $610 per ton. A comparison of the returns from the smelting company with those from the cyanide plant shows that there is a substantial saving by cyaniding over shipping to the smeltery. This treatment will also permit of quicker realization by saving one-half to three-quarters of the time now taken by the smelting company before remitting for shipments received by them. The results thus far obtained are very encouraging and it is expected that during this year the successful outcome of the project will be fully determined.

Pinguico Mines Company

The report of the consulting engineer in charge and a careful personal examination made by the president of the company show this property to be in excellent condition and indicate that the ore reserves on May 1, 1909, plus the ore that the opening of the ninth level will probably put in sight, make reasonable the assumption that there is available above the ninth level over 148,000 tons, worth at the present price of silver over $2,000,000 and which should yield a net profit of nearly $1,000,000. The past history of the mines in Guanajuato and a study of the geology of the camp afford reason to expect that the mineralization of the Pinguico vein will continue to much greater depth. The dividends on the Pinguico Mines Company preferred stock, owned by the Guanajuato Development Company, amounted during the last year to $48,753, equivalent to a little more than four-fifths of the dividends for the current year on the preferred stock of the Development company.

A great deal of development work has been done in the mine since the last annual report, and while a large portion has been on the vein and in ore, much dead work has also been done. Both the Fortuna and Pinguico shafts have been sunk to greater depths during the year. The seventh level has been greatly extended to the north and the entire eighth level has been opened up during the year, until it now has a length of about 1300 ft. from the shaft.

Diamond-drill holes from the Fortuna shaft to the vein located its position, and a crosscut from the fourth level has now reached the vein, which shows the same conditions existing as upon the upper levels in the old portion of the mine. There is every reason to expect that further work at this point will give as good results in the way of ore as was found in the older workings.

The eighth level of the mine, as opened from the Pinguico shaft is entirely in ore, but of varying value, a portion being barely pay ore and the remaining portion being very profitable. At the southeast end of this level there have lately been found intrusions of ore bearing so great a resemblance to the new ore shoot of the adjoining Carmen mine, that it appears certain that this valuable ore shoot is dipping directly into the Pinguico mine, and that below the eighth level there will be found a valuable body of ore distinct from that which is now being worked. The continuance of the older orebody in depth seems well assured and preparations are being made to open up the ninth level as quickly as possible.

Mine Conditions

The mine plant is in first-class condition as regards buildings, machinery and underground workings. It was hoped that the cost of mining would have been reduced toward the end of 1908, but due to extensive development work this did not occur. At present the cost of mining soft ore, now going to the mill, is much reduced and during the period of more limited development work, mining costs will unquestionably be less.

The amount of water has greatly diminished until it is now only about 50 gallons per minute, but sinking to the ninth level may release large quantities of water, and preparations have been made to handle it. A contract has been made with the owners of the adjoining Carmen mine permitting the introduction of air and the exit of water through the tunnel of their mine, thereby relieving the company of large expense for elevating water to surface and for pumping air into the mine. In compensation for this the Pinguico company has deeded a small piece of ground belonging to its Calderones ranch to the Carmen company for a mill site.

The transportation of the ore from mine to mill over the railroad of the Mexican Milling and Transportation Company has been satisfactory and the cost has steadily decreased as better equipment has been provided, both by the road and in the dumping arrangement of our own bins. The cost has decreased from a maximum of 43c. per ton, to a present cost of 12.5c. per ton.

Pinguico Mill

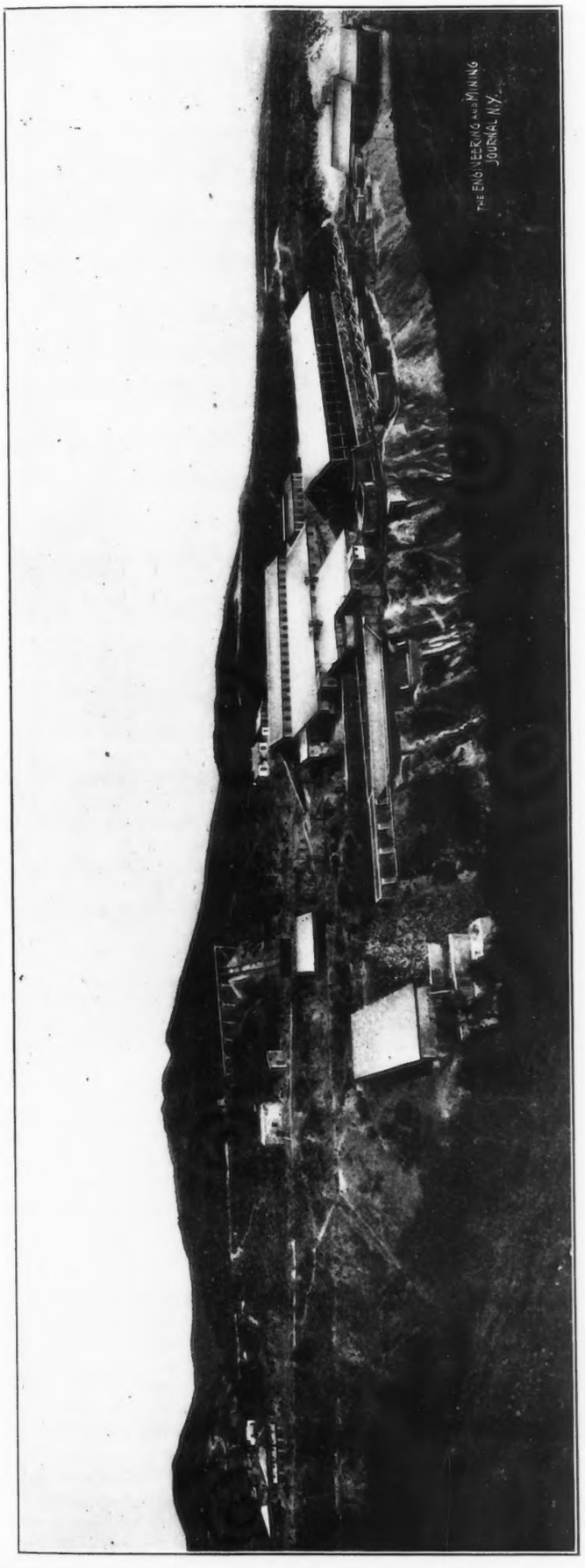
An automatic sampling plant has been added to the mill for the purpose of obtaining more reliable mill head samples of the ore. No other equipment or improvements of consequence were installed during the year. All of the machinery is in good working order, but there is no doubt that the changed condition of the ore in the mine, since the mill was first designed, would make tube mills of more benefit for regrinding than the present Chilian mills and it is to be hoped that financial conditions will permit a change in this respect.

The gross value of the product recovered by the mill and sold was 85.45 per cent. of the value of the ore put into the mill, as based upon head samples taken. The actual tail samples would indicate a slightly higher extraction, which is to be partly accounted for by the metals in suspense in the mill.

While milling lower-grade ores for the last six months, a larger tonnage was being forced into the mill in order to procure larger commercial results, and the effect has been a poorer extraction during that period. Higher-grade ore is now being milled and the extraction based upon actual tailings going out would seem to show about 90 per cent. recovery. The cost of milling last year was $2.11 per ton and with higher-grade ore and the necessity of using more cyanide, the milling cost per ton will probably be somewhat higher for the next few months. At present the mill heads are being kept at about $20 per ton and so long as this grade of ore can be maintained, excellent profits will be realized.

Financial Statement

The company shipped to the smelters 536 metric tons of high-grade ore, upon which was realized $127,105. The receipts from bullion and concentrates sold were $956,982 and from miscellaneous revenues $135, making the total revenue from all



PEREGRINA MINING AND MILLING COMPANY'S 500-TON CYANIDE MILL AT GUANAJUATO, MEX.

sources $1,084,222. The total mining, miling and general expenses were $688,533, leaving the net profit over operations, $395,689, and after deducting $120,000 paid in dividends, the remaining surplus amounts to $275,689. Property, options, franchises, etc., were charged off or depreciated $93,646, which leaves a surplus for the year of $182,043.

During the year, in addition to paying interest, the company reduced its obligations $180,335. There was also expended on construction and asset accounts, $92,473. The previous surplus of $33,917, added to that for the present period, made a surplus of $215,960 at the end of the fiscal year.

Peregrina Company

The Peregrina Mining and Milling Company realized during the year $743,701 in gross earnings. The mining, milling and general expenses for the period amounted to $649,686, leaving a profit of $94,015, and after paying dividends of $70,000 there was added to the surplus $24,015. In addition to paying its interest charges and general expenses, the company reduced its obligations $6,775, expended $34,820 on construction and $7,620 for equipment.

It was hoped that a better grade of ore would be obtained from the mine and that the value of the ore entering the mill would be correspondingly increased, but because of the greater width of vein broken, the grade of the ore has been about 39.5c. per ton less than during the previous year and the profit has been correspondingly less.

The development work during the year showed the existence of large orebodies on La Cruz parallel vein, and in depth below the most southerly blocks on the main vein, and more recent work shows the undoubted northerly extension of the main vein, as well as the continuance of its orebodies in depth in the end of the mine. While these tonnages are not measurable at once, there is every reason to consider them available for the future working of the property, so that no fear of lack of ore supply need be felt. The accompanying table shows the value, costs and profits, per dry ton, for the last two fiscal years.

This indicates a decreased value of ore per ton of 39.5c., of which the depreciation in silver accounts for 31c., so that the difference in metal content per ton is very slight. The metallurgical loss during the last year has been less than in the previous year and the net value recovered has consequently been greater in proportion.

The total production cost, including realization of values, has increased 23c. per ton over the previous year, chiefly because of the larger quantity of mine ore sent to the mill, with the correspondingly greater expense. The difference in profit per ton in favor of the previous year is

also due to the same causes—less gross value and greater cost per ton. It is believed that the cost of production can be decreased during the coming year, and every economy will be practised with that end in view.

Recovery of Metals

The recovery for the year shows a gain. This would have been much larger if it had not been for large metallurgical losses during September, October, November and December of 1908, caused by an effort to improve and cheapen the extraction process. The recovery for the first four months of the fiscal year shows 78, 79, 83 and 84 per cent., for the second four months, 65, 74, 72 and 80 per cent.; a return to former methods shows a recovery for the last three months of 83, 87 and 92 per cent. There is excellent reason to believe that the recovery can be kept at about 90 per cent.

The later months of the fiscal year also show a gain in the grade of ore entering the mill and, judging by the grade of ore available in mine, dumps and fillings, the present grade should be maintained and possibly increased. The continued profitable operation of the mine and mill necessitates the most careful attention and economy, and the results obtained during the most successful months of last year indicate what may be expected during the present year.

Milling and Transportation Company

The original plan upon which the Mexican Milling and Transportation Company was formed is not only attractive but thoroughly sound as a business proposition. If the financial depression of the past two years had not delayed the completion of the railroad and the enlargement of the milling capacity, the project would undoubtedly have resulted in large profits. There is a large tonnage of ore along the line of the proposed railroad, which will be available as soon as a large mill is built and cheap railroad transportation is provided. It is proposed to complete the railroad and build the mill as soon as the necessary funds are provided by completing the financing of the company. This will stimulate the production of ore from mines which are now idle because their ores will not yield a profit over the present high cost of transportation by burros and mules.

Water Supply

At the time the Guanajuato Development Company was organized the cyanide treatment of ores as then developed required about four tons of water per ton of ore. The plans of the Development company in connection with Pinguico, La Central, El Cedro, Mizpah and other mines, and with such mill construction as this development work might warrant together with the proposed construction of mills by other companies in the immediate neighborhood, indicated that the question of a suitable water supply was one of vital importance.

Careful investigation of the surrounding country had demonstrated that the only drainage basin from which a large constant flow of water could be economically obtained was the San Isidro ranch. The Development company accordingly purchased this ranch as an aid to the large development and milling projects which it had in view.

The following year preparations were made to build the proposed dam but the improvements in cyanide milling, which greatly reduced the amount of water required, together with the effects of the panic of 1907 caused a suspension of work on the dam and it has not been resumed. However, the past season has demonstrated the necessity of an ample and steady outside supply of water for the Pinguico and other mills planned or under construction in this district. Without this supply, milling operations are impossible.

In addition to water for milling purposes there is a large area of land to which water from the proposed dam can be supplied for irrigation at a good profit. It was estimated that the cost of the dam and pipe line would be about $100,000 and that the sale of water would yield $50,000 annually. In view of these facts the Development company, as soon as it has funds available for the purpose, will give careful consideration to the question of completing the dam and pipe line.

COMMERCIAL ASPECT OF PEREGRINA ORES.

	Gross Value.	Net Loss.	Net Value Recovered.	Cost, Inc. Realization.	Profit.
1908.....	$7.09	$1.65	$5.44	$3.77	$1.67
1909.....	6.695	1.325	5.37	4.00	1.37

The revenue from the ranch for the year from the sale of lime, charcoal, firewood, timber, barley, alfalfa, etc., was 130,879 pesos and the expenses for the year were 119,130 pesos, leaving a profit of 11,749 pesos. It is proposed to stock the San Isidro ranch with sheep and hogs which should be exceedingly profitable. The yield of barley, alfalfa, etc., can be largely increased so that in a few years the income from the ranch will pay good interest on the investment, in addition to the revenue from the sale of water when the proposed dam is built.

La Central Mines

This group of mines has produced a large amount of ore in the past, averaging over 2 oz. of gold per ton, in addition to the silver content. The development work upon the mines was mostly done previous to thirty years ago and indicates the presence of a large number of veins, some of which are of sufficient value to warrant the belief that if properly developed, a group of paying mines will result. The former owners of the Pinguico mines spent $150,000 before finding any ore of value, and the La Central group, judged by surface indications, the number of veins carrying pay ore, and the cheap method of development, offers far better results than did Pinguico. The veins as far as they occur in rhyolite, and most of them do, bear a strong resemblance to the Pinguico vein, both in the walls and the soft wet character of the ores, and there is good reason to believe that development work will result as well as it did in Pinguico. When the Development company has available funds it would certainly be good policy to further develop this group of mines and demonstrate their value.

El Cedro Mine

This mine has been worked at various points for over a hundred years and several distinct ore shoots have been found and partially worked. It is a large, low-grade mine, and to be made profitable requires an equipment of mining machinery, and the expenditure of a considerable sum of money to put it on a paying basis. The small amount of ore now being mined by hand work cannot be made profitable under the present conditions and while depending on other mills for treatment, but if properly developed and equipped with a mill of its own of sufficient capacity to treat with the greatest of economy the immense bodies of low-grade ore which are known to exist, this property could undoubtedly be made to pay a reasonable profit. The project, in brief, can be stated as a mine extending about 1½ miles along the Mother Vein of Guanajuato, with five vertical shafts and one incline shaft and about five miles of workings connected with these shafts. The vein varies from 30 to 60 ft. in width, and with sufficient ore to warrant building a mill and commencing development work.

In the light of the business conditions which have prevailed during the last two years, the stockholders of the Development company may congratulate themselves on the good results of the year's operations. The dividends on the preferred stock have been paid and a substantial surplus remains after a liberal allowance for depreciation. There is every reason to expect continued dividends from future earnings and with an advance in the price of silver, the company will be able to show a large increase in its business and profits.

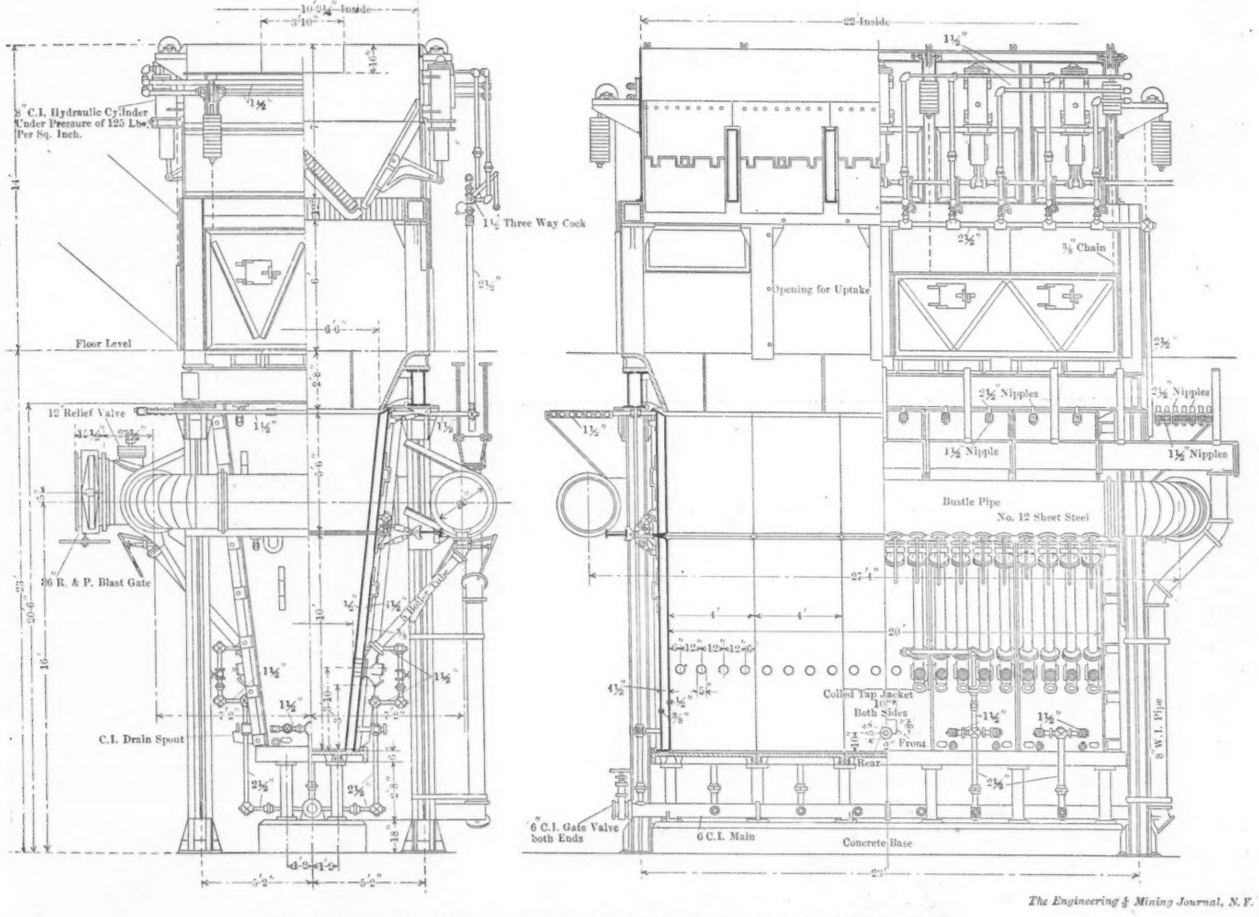
At the El Bote mine, Zacatecas (*Mex. Min. Journ.*, Aug., 1909), Chile mills crush 18.6 tons of hard dense ore through 180 mesh, 70 per cent. passing 200 mesh, in 24 hours.

New Copper Blast Furnaces at Teziutlan Smeltery

Each Furnace Charged Mechanically at Five Points. No Brickwork Used in Construction. All Piping Fitted with Cross Connections

BY CYRUS ROBINSON*

These notes are intended to briefly describe the Robinson copper blast furnaces just installed at the Teziutlan Copper Company's smeltery situated near Teziutlan, Mexico. The accompanying drawing shows the end and side details, and gives the principal dimensions and the general arrangement of the furnaces. The new furnaces, shown in end and front view in the accompanying illustrations are a development from the design worked out by me at El Paso, at the time of the rebuilding of that plant, after the fire about eight years ago. It was decided at the time of rebuilding to install mechanical charge for the lead furnaces, and later to put in two copper furnaces. The normal feed floor of the copper furnaces was 10 ft. below the feed floor of the lead furnace, and it was desired to charge all the furnaces from the same system, hence the use of a bin intermediate between the lead feed floor and the copper furnace. The charge was taken up to the lead-furnace feed floor in electric charge cars and dumped into the bins directly over the copper blast furnace, being fed from these bins to the furnace as required. The system worked so well that it was adopted on other furnaces at El Paso and later, I believe, has been adopted at Cananea.



The Engineering & Mining Journal, N. Y.

END AND FRONT ELEVATION DRAWINGS SHOWING DETAILS OF CONSTRUCTION

Bins and Charging Mechanism

The Teziutlan furnaces are a further refinement of this principle, there being located over each furnace a 65-ton bin, the charge car running directly over the top of these bins. The bins over the furnaces have five dividing plates, practically cutting the bin into five sections, these dividing plates extending about halfway up the bin, as shown in the drawing. Each of the compartments has two gates, each gate operated from a hydraulic cylinder, the gate being opened by allowing the water to escape from above the hydraulic cylinder piston and the weight of the ore to force the gate to open. All of the 10 cylinders are controlled from one bank of levers in front of the furnace and by looking into the furnace it can be seen at what point it is desirable to feed a charge and the corresponding gate is opened. There are, therefore, 10 points at which the furnace can be fed from this bin. This gives practically the same control as feeding by shovel, as the item of charge is directed to the point where required and as required.

The efficiency of the charge handling for one or two furnace plants is materially im-

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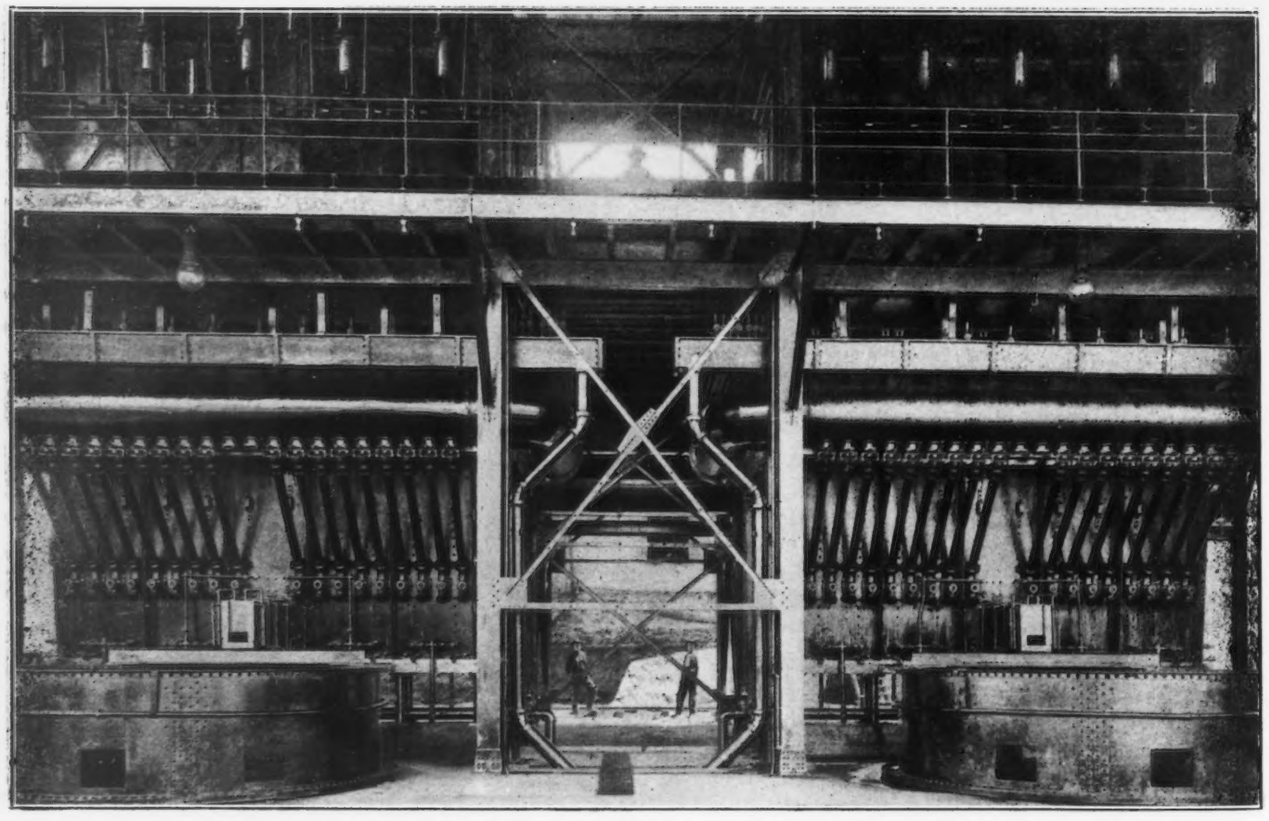
SMELTERY OF TEZIUTLAN COPPER COMPANY, NEAR TEZIUTLAN, MEXICO

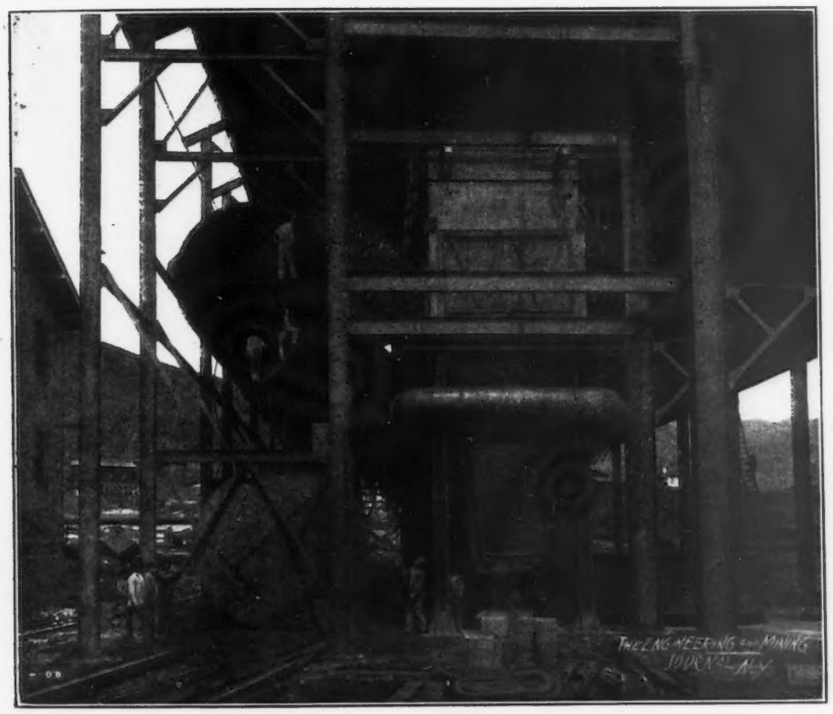


FRONT VIEW OF NEW COPPER BLAST FURNACES AT TEZIUTLAN SMELTERY

proved, as the delivering of the charge to the furnace bins can go on, within the range of the bin capacity, without regard to the feeding of the furnace, and the furnace can be kept full to the top mantel plate keeping a uniform burden as against the intermittent feeding of the furnace by charge car directly into the furnace.

General Construction and Water-jacket System

In the construction of the furnace no brickwork is used, the bin being supported on hollow cast-iron columns, through which air circulation is provided. The furnace is equipped with a system of jacket piping whereby a discharge from every jacket is seen from the furnace house by simply looking up over the water launder; it is not necessary to go from the front of the furnace to ascertain whether



END VIEW OF FURNACE SHOWING STEEL CONSTRUCTION AND BINS

a jacket is running or not, the stoppage of the circulation from any jacket being noticeable at a glance.

Another departure is the use of cast-iron launder instead of the usual steel one for carrying the water to waste from the jackets. All of the piping is fitted with bronze cross-connections so it is possible by taking out the plugs from the crosses to run a rod through any piece of pipe without taking the same down or unscrewing elbows and connections.

The drawing shows the system of holding in the jackets by heavy crucible flange plate and wedges, and I-beams carried by mantel columns with thrust turnbucklers, making it possible to take out any jacket without disturbing any other part of the furnace.

Changing Conditions in Mexico

By H. A. Megraw*

That times change, and that circumstances alter cases are well known facts. The duties which the mining engineer is called upon to perform, in the carrying out of his mission in various parts of the world, are steadily altering in one way or another. These changes are not uniform over the whole field of mining, as would be supposed, but vary locally, and although in some cases they may not be noticeable over short periods, a comparison of conditions at widely different dates will be likely to show the changes forcibly. In order to take a familiar example of this fact, examine the case in Mexico. And the forces which are at work here will be found to be at the same work, in a greater or less degree, in other parts of the world.

In the beginning, the engineer from home, wherever that might be, was obliged to carry the burden of his whole operations on his own back. He had to formulate his policies and devise methods and means of applying them. The things he learned from the natives, while interesting and instructive, rarely were of such nature as to be economically of great importance.

All the skilled assistance which he found necessary had to be imported from home and a goodly price paid for it. His directions were given to these men, and upon them he had to depend for the intelligent carrying out of his schemes. Upon them rested the success or failure of his work, for it was not an easy matter to replace one of these assistants whose work was not all it should be. The natives were used as the machine, furnishing the motive power for strictly mechanical movements. The more skilled men from home soon found out that it was an easy matter to delegate all physical work to the native, he furnishing the brain for its proper carrying out.

These men imported from home were of several classes. Some of them were intelligent and ambitious; others intelligent enough but not in the least ambitious and content to perform the day's work in a routine way, to learn what little was absolutely necessary, taking it for granted that the supply of work of this class was always before them.

Natives Taking Better Positions

Meanwhile, in the course of time, the native laborer began to realize his position and to see that he was being used as an unthinking machine, and that labor of that class commanded the lowest possible price in the market. He began to take pains to observe what was going on about him and to learn all he could about the work he was doing.

As time progressed he went farther than this. The younger generation began to serve a sort of apprenticeship in the shop, mill and mine, until a great many of them were more or less competent to undertake the kind of work which paid better. This class of worker found that his pay increased in direct proportion to his efficiency.

This kind of education is the most effective that can be devised. To one who finds that his services command more money as he learns more, the incentive to go on learning and earning is well nigh irresistible. The native has now learned enough so that he can run a shift in the mill or in the mine, operate a machine in the shop and do a number of other things which he never thought of doing ten years ago. Perhaps he can do none of these things yet as well as his foreign competitor, but still in many cases acceptably, and, under capable supervision, satisfactorily.

The prospect is that some day, not so very far in the future, he will be in a position to entirely supplant the skilled laborer from home. The native can work for less money than the man who is imported. This holds good in almost all cases. The native can live entirely on the products of his country, and almost always does, while the imported man finds it difficult and uncomfortable, if not impossible. The imported man is very

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apt, in these cases, to decry the work of the manager who supplants him with a native. It is considered an unpatriotic move and the manager comes in for some forcibly uncomplimentary language, while the imported man has to hunt another job. At the same time the work is being performed just as well and for less money, which is certainly the thing to be desired. The move is not unpatriotic, for the aims of the company owning the property are better fulfilled, and, at the same time, justice and fairness seem to point to the fact that the native ought to be recognized when he is capable of doing the work.

The laborer from home fails to go into the psychology of the situation. Its inevitableness does not appeal to him. He fails to consider that he is a machine which has been used for a certain purpose, which, while still intact and doing good work, is being, and naturally will be, replaced by the new machine which will do the same work for less money. It is the same with men as with machines.

Manager Must Serve His Company's Interests

The uptodate manager will put in a new machine the minute it is clear to him that he will save money by doing so. The same happens with men. The manager in justice to his company and his reputation cannot afford to overlook the chance to reduce expenses.

The greatest objection to the use of the lower classes of foreign labor up to the present time has been their lack of honesty. The uneducated native has an inborn proclivity for stealing anything he can get away with, no matter of how little value, and regardless of the fact that it may be of no use whatever to him either to use or to sell.

Conditions in the past are largely responsible for this tendency. There was a time when the lower class necessarily had to steal to live. Education and experience, however, are rapidly proving to the native that it is bad policy to steal and that he can get along much more successfully by being honest. There are many years of education before some of them before this principle becomes universally acknowledged, but many of them have already learned it and it is not such a difficult matter to pick out the ones who have.

The manager who realizes all these things, these changes which are constantly taking place, and makes use of the native with judgment and intelligence, is making the best of his opportunities, getting the best possible results for the owners of his property and doing his patriotic duty to the fullest extent. He is not employed to make work for anyone but to secure the most economical possible results, and he is undoubtedly expected to use his brains to that end.

Getting the Viewpoint of the Workmen

For the man who cannot converse intelligently in the native tongue it is very difficult to accomplish the best results. It is not necessary that a mine manager should be able to use all the flowers of some of the foreign tongues, nor absolutely be able to always use the right word in the right place. It is advisable, though, that he should be able to understand the meaning of the colloquial speech and to be able to give intelligent answers. It is not alone the difficulty of actual speech that makes the difference. Anyone can have an interpreter, but not by any such means can one understand the point of view of the native.

The Anglo-Saxon has a peculiar point of view and an idea that everyone else in the world ought to learn English for his particular benefit. The man taking this stand cannot possibly hope to establish anything like a bond of sympathy with the native. That is where the fault of language comes in. The viewpoint of the native cannot be understood, he cannot be handled in the most efficient manner, and often chaos is the result.

In such cases the manager has no alternative but to keep on with his imported labor at a high price. Many men have that natural faculty of sympathy which enables them to understand the views of others often disregarding the spoken word. These men are doubly fortunate and doubly valuable, for they will always achieve results completely out of the power of the man who does not possess it. Such men get along well with natives, understand their ideas and have the faculty of getting the best work out of them. They never make themselves familiar with their employees, for when that begins, the end of profitable work is in sight.

The laborer from home is on the horns of a dilemma. It is impossible for him to accept the native wage scale. Therefore he must either rise in his profession and fill the higher places, or he must get out. The vacant places are higher up. At the bottom there is no room.

Many men formerly occupying the lower places in the profession have made it their business to study conditions and fit themselves for the better places. Many have succeeded and are reaping the reward of stability which can hardly fail to come to one really in earnest. The triflers are disappearing, many have gone already and others are going. Those who study changing conditions closest and make the best use of their knowledge are, and will always be, the ones who progress most rapidly.

Small Smelting Plants in Mexico

By R. W. Perry*

The small blast furnace played a most important part in the early development of the lead and copper deposits of the West, and the experience gained in their operation paved the way to the present high state of efficiency of the art of smelting.

Much of this advance has been made possible by the increased size and capacity of the furnaces and the employment of the best metallurgical talent while the small furnace has been neglected accordingly and very little progress has been made in its management. The majority of such plants installed during the past 20 years have been lamentable failures; in many instances due to the fact that the character of the ore was unsuited to smelting, but in more cases to the lack of knowledge of those in charge. As a consequence, suggestions as to their use are looked upon with suspicion by many mining men, except in the case of simple oxidized ores where an abundance of iron flux is available.

I wish to describe several successful plants which have come under my observation during the past few years' operating under unfavorable conditions, and showing conclusively that the small furnace is capable of being adapted to a greater variety of ores and, consequently, to a much more extended use than is generally thought possible.

Two Small Smelteries in Successful Operation

The smelteries of Socavon and Linguna are the property of O. & T. Braniff, of Mexico City, and are situated near Maconi in the southeastern part of the state of Queretaro. Maconi is about 50 miles from the station of Bernal, on the main line of the National Railroad of Mexico, with which it is connected, for the greater part of the distance, by a good wagon road. Supplies must be packed over the last 15 miles to the smeltery at Socavon, and to Laguna, 15 miles farther. The smeltery and mines at Socavon have the benefit of cheap electric power developed at the company's own plant and, at the time of my connection with it, the line was being extended to Laguna.

The ores smelted at Socavon are chiefly oxidized silicious ores of the following approximate composition: SiO_2, 46 per cent.; Al_2O_3, 18; CaO, 10; Fe, 10; Sb, 5. Silicious lead ores carrying considerable lime are brought from the mines of San Entierro, at Laguna, to make up the deficiency in lead when necessary.

The ore occurs in a limestone formation, probably of Cretaceous age, and the

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deposits are very irregular both in form and value. Sulphides occur at variable depths and become common at a depth of 1500 ft. They contain a much higher percentage of iron and antimony than the oxidized ores, and, as a general rule, more silver.

Although out of place in this article, some mention of a body of mercury ore encountered at a depth of 1000 ft. may be of interest. About 100 tons of ore running high in mercury were extracted from a stope of ordinary oxidized ore. Some of this ore assayed as high as 20 per cent. mercury, which was present principally as livingstonite accompanied by native mercury, cinnabar and other rarer minerals. Traces of mercury have been also found in other parts of the mine. Numerous deposits of mercury ores are reported from the district.

The Socavon Plant

The equipment of the smeltery consists of two square 36-in. water-jacketed furnaces made by the Colorado Iron Works. The jackets are 3 ft. high with a 6-in. bosh, and have three 3-in. tuyeres on each side and one at the back. Blast is supplied by a Connersville blower. The sides of the furnace are straight, and the distance from tuyeres to feed floor is 15 ft. There is no dust flue, the furnace gases being discharged directly into the atmosphere. An auxiliary steam plant is provided in case of accidents to the electric plant.

The ore as brought from the mine is dumped over grizzlies and the fines reserved for future treatment, anything smaller than ¾ in. being regarded as fines. Mining is done on the *buscone* system and each miner sorts his coarse ore, throwing out all waste possible. During this operation the larger pieces are broken to a maximum size of 4 in., in which condition it goes direct to the beds. The sulphide ores are separated into coarse and fines, the coarse ore being heap-roasted, and the fines briquetted and roasted in kilns.

The different classes of ore, briquets, roasted matte, etc., are added to the beds in 6-ton layers in a certain definite order, and enough litharge added at intervals to keep the lead content up to 8 per cent., or higher when sufficient lead is available. The object of always preserving this order in forming the beds is to be able at any time to know their approximate composition and, if necessary, to send ore from any bed to the furnace without waiting for the chemist's analysis. Charges made up in this way need only a slight correction after the complete analysis is at hand. Analyses of different beds vary within somewhat narrow limits, chiefly dependent upon the amount of roasted matte on hand at the time of forming the beds. These limits are as follows: SiO_2, 36 to 28 per cent.; FeO, 22 to 32; CaO, 8 to 5; Al_2O_3, 12 to 8; ZnO, 2 to 4; S, 2 to 4; Pb, 8 to 10; Sb, 6 to 7.

Iron Ore Must Always Be Added

Whatever matte is produced at Laguna is roasted and brought to Socavon to make use of its iron content. However, there is always a deficiency in iron and some flux is necessary.

The ore from the beds and the fluxes are mixed on the feed-floor and fed to the furnaces in charges of 400 to 500 kg.; 15 per cent. fuel is used, of which ⅓ is charcoal and ⅔ coke. The limestone is quarried near the smeltery and is very pure, running 97 per cent. $CaCO_3$.

The iron is mined from two veins a few miles distant. Its average composition is given in an accompanying table:

IRON-ORE FLUXES.

	SiO_2	FeO	CaO	Al_2O_3	Ag
	Per Cent.	Per Cent	Per Cent	Per Cent.	Gm.
Espolon mine.	20.0	55.0	2.0	2.0	40
Poblano.....	13.0	40.0	11.0	11.0	100

The charge is carried at a hight of 9 to 15 ft. above the tuyeres. A blast pressure of 8 oz. is maintained at the blower, which is provided with a valve to keep the pressure constant irrespective of the condition of the furnace. The lead is carried low in the well so as to leave a thick layer of matte below the tap-hole. By leaving this matte in the furnace any tendency of the lead to run out of the tap-hole when crusts begin to form, is avoided. Campaigns of several months are the rule, the furnace being generally blown out from some external cause rather than on account of difficulties within. The slag and matte are tapped together into small slag pots and allowed to cool on the dump. They are then broken up and the matte sent to the roast heap and the dirty slag returned to the furnace.

Daily Capacity of 25 to 35 Tons

From 25 to 35 tons of burden are smelted per day, and approximately 2 tons of bullion and 1½ tons of matte produced. The matte contains 1600 gm. silver, 12 per cent. lead and 8 per cent. antimony per ton. The combined percentage of lead and antimony in the charge seldom exceeds 10 per cent. and is generally below that figure. I append an approximate analysis of the slag produced: SiO_2, 34 per cent.; FeO, 32; CaO, 20; Al_2O_3, 8; ZnO, 3.5; Pb, 0.7; Sb, 1.5; Ag, 70 gm.

Slags carrying as much as 36 per cent. silica and 24 per cent. lime have been made. The lead and silver contents of these slags were low, but the antimony was much higher and the loss of antimony by volatilization was greatly increased. This loss by volatilization is evident in the decrease of the antimony content of the bullion. Whenever, from any cause, the furnace is running irregularly, the same variation in the assay of the bullion is noticed. The bullion assays: Pb, 55 to 82 per cent.; Sb, 42 to 16.

All coarse sulphides and matte are roasted in heaps of 20 to 50 tons and allowed to burn as long as possible. Any poorly roasted ore is returned to a fresh heap. This method is most unsatisfactory as the matte sinters easily and a large proportion must be reroasted. The loss of lead and antimony is large. Comparative analyses are given in an accompanying table.

The sulphide fines are mixed with water and made into bricks in ordinary brick molds, thoroughly dried and charged into kilns with a little brush on the bottom to start combustion. These kilns are about 15 ft. in diameter and 20 ft. high, and take a charge of 30 tons at a time. Thirty days are needed to roast a charge, at the end of which time the sulphur contents are reduced to 6 per cent. The total cost of briquetting and roasting is 60 centavos per ton.

35 Tons of Bullion Refined in 8 Days

The refining plant consists of an octagonal cupeling furnace 12 ft. in diameter, capable of taking a charge of 35 tons of bullion. The bottom of this furnace is of clay, well tamped down and sloping from a point 2 ft. below the top of the bridge to the center at the bottom of the furnace. There is an opening in the front of the furnace 2 ft. wide extending from the floor to the top, through which the litharge is withdrawn. Blast is supplied by a small Baker blower delivering to the back of the furnace through two 3-in. tuyeres.

The furnace receives its full charge of bullion and, when completely melted, is cooled and the dross raked out through the opening in front. This dross, which contains 30 to 35 per cent. lead and antimony respectively, is returned to the blast furnace. As the surface of the lead bath is lowered, the clay is gradually cut away from the opening in front to allow of the withdrawal of the litharge. This is continued until the cupellation is finished. After the furnace has cooled sufficiently to permit it, the silver is taken out, cut into pieces of sufficient size and melted in graphite pots. Great care is necessary at the end of the cupellation to keep the enriched lead from freezing, but experienced workmen have no difficulty in producing bullion assaying 990 to 995 fine. About eight days are necessary to finish a charge of this size, and less than a cord of wood is consumed per ton of bullion cupeled. The litharge

produced assays 160 gm. silver per ton and 90 per cent. lead.

High-Silica Slags at the Laguna Smeltery

The smeltery at Laguna is of interest chiefly on account of the high-silica slags made there. The furnace is a circular, water-jacketed furnace 36 in. in diameter. It has three 2½-in. tuyeres, and smelts 15 to 20 tons of charge per day. On account of the scarcity of iron flux the slags are very high in silica, ordinarily running as high as 38 per cent. silica, but sometimes rising to 44 per cent. No difficulty is experienced in keeping the furnace in blast with 44 per cent. silica in the slag, but the silver and lead losses increase rapidly when the silica rises above 38 per cent. The loss by volatilization is not known as no analysis is made

PARTIAL ANALYSIS OF RAW AND ROASTED MATTE.

	Ag.	Pb.	Sb.	Fe.	S.
	Gm.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Raw matte..	1600	11.0	8.0	44.0	23.0
Roasted mat.	1000	8.0	4.0	40.0	9.0

of the charge fed to the furnace, but it must be high even with the lowest-silica slags. The following is a typical analysis of a slag from the Laguna plant: SiO_2, 38 per cent.; FeO, 32; CaO, 18.5; Al_2O_3, 3; ZnO, 2; Pb, 1; Ag, 90 gm. The bullion assays 92 per cent. lead and 5 per cent. antimony.

Smelting Copper Ores at Zimapan

The Equitativa smeltery at Zimapan, Hidalgo, is situated 25 miles from Maconi and 50 miles from the station of Sayula on the National Railroad.

At the time of my visit a 36-in. circular furnace was running on copper ores; 9 per cent. coke was used as fuel and a concentration of 12 and 15 to 1 was made on ores carrying 3.5 per cent. copper and 9 per cent. sulphur; 14 oz. of blast was used and 30 tons of charge were smelted per day, the average slags running 48 to 50 per cent. silica, 16 per cent. lime and 20 per cent. iron. I was told that slags carrying as high as 60 per cent. silica had been successfully produced. The slag and matte were tapped together and separated on the dump.

While no claim can be made for high metallurgical efficiency in these plants, the losses are within reasonable limits and compare favorably with those at many larger reduction works. The preparation of the ore for the furnace plays as important a part as the smelting, and the recent improvements in the roasting of lead ores, which can be utilized by small as well as by large plants, make possible the successful smelting of sulphide ores which formerly could not be treated by themselves.

Oil Developments in Mexico

Special Correspondence

The action of the Mexican Central Railway in changing some of its locomotives back from oil to coal is in the line with the reports that the Mexican oilfields of the Tampico district have not given promise of longevity and large production. It is difficult to get reliable information on the subject. A report says that the Ebano wells of the Mexican Petroleum Company are pumping an increasing amount of salt water, and that now some of them are carrying up as much as 8 per cent. of brine. The famous Dos Bocas well, over which there was so much excitement owing to the great difficulty in controlling it, is now a prolific producer of brine, and the oil has become of small proportion in its large daily artesian flow. It is also known that the results obtained by the Pearson oil interests near Veracruz were disappointing.

It is not meant to convey the idea that the Mexican oil developments on the gulf side are not important and large, or that the fields will be a failure, but to point out that the generally accepted claim that Mexico would soon have a surplus of crude oil and be a factor in the markets of the world is not yet substantiated. This is in corroboration of the semi-mysterious report made to the United States Government by Messrs. Hays and Day, of the Geological Survey, who were sent into Mexico officially last winter. Efforts to locate oil in other parts of Mexico than the Gulf coast have not been successful as yet.

The Hearst interests have some deep wells in the northeastern part of Chihuahua on which they are continuing exploration, which fact leads to a conclusion that the work done has been at least encouraging. On the Isthmus of Tehuantepec and in Chiapas are indications of oil and the results obtained by the Pearson explorations in the isthmus region have been fairly satisfactory. There have been no results so far from the limited attempts to develop oil on the Pacific slope. There seems to be no reason why oil may not be expected from the Sonora and Sinaloa coast region, as in California. Farther south along the coast there has been such intense vulcanism that the conditions for oil are not considered very good. So far no oil has been found in the vast limestone beds of the central Plateau region of the country, although there has been little deep drilling. Recently the railroads and some private interests have been sinking many deep drill holes in various parts of the plateau with the expectation of obtaining water, and it has been hoped that some of these might disclose oil strata. So far there have been no results from this work.

The oil business of Mexico has been in the control of the Waters-Pierce company for many years until recently, when the Mexican Petroleum company became a producer, and later the Sir Weetman Pearson concern became interested in the oil explorations under special concessions granted by the Mexican government with the hope of dividing the oil interests in the country and also of increasing the prominence of British investments to offset the growing preponderance of the American interests. The Waters-Pierce company is an adjunct of the Standard Oil Company, and held the Mexican field on a contract to control it for the Standard. This was easy before the discovery of oil at Ebano. The Mexican Petroleum Company was controlled by Doheny, Canfield, *et al.*, of California, who were, in a measure, independent of the Standard.

When the Ebano field came in, it was expected that there would be competition in Mexico, but the Mexican Central Railway, then controlled by the same people who were in the Waters-Pierce adjunct of the Standard, made a contract for all of the oil of the Mexican Petroleum Company for fuel for the locomotives. When the Pearson interests discovered oil and commenced to produce and to refine it, the situation changed and the Waters-Pierce company was unable to dominate the powerful British interests back of this new producer, and last winter a more or less cruel war was inaugurated, particularly in the city of Mexico, and prices were greatly cut, principally in the newspapers and on enormous bill boards.

This was the cue for the Standard to come in on the grounds that the Waters-Pierce company had failed to control the field. Recently a Mexican company has been announced to acquire the business of both companies. The capital of the new company is 25,000,000 pesos, and the governor of the federal district is at the head of it. This seems to be the last stage in the commercial development of the Mexican oil business. It is a question now of the production and grade of the developing fields and of the results of the explorations for new wells. The Pearsons have discontinued the policy of promiscuous drilling and lavish expenditure for refinery and equipment. The oil war is over, apparently, also. Meanwhile there has been but little benefit to the country from the oil discoveries so far made, and the prospect of a cheap supply for industrial purposes is not yet assured.

At Cananea, it is stated in the *Mex. Min. Journ.*, Aug., 1909, wages are from 3 to 3½ pesos per day, and a premium of 50 centavos per day is paid those who work 28 days a month.

In the Guanajuato district of Mexico gold and silver ores are mined and treated for less than $4 a ton, and over 90 per cent. of the value is extracted.

The Coal Industry in Mexico

Important Coalfields Have Been Discovered and Are Being So Developed that Mexico May Soon Be Independent of All Foreign Fuel Supplies

BY EDWIN LUDLOW*

There are at present three developed coal basins in the state of Coahuila. These basins are all traversed by the Mexican International railroad. The first district lies 7 km. south of the town of Porfirio Díaz, and is known by the name of "Bassin de Fuente." The second field is situated 117 km. south of Porfirio Díaz, and is called the "Bassin de Sabinas." The third basin lies near the station of Barroterán, 145 km. south of Porfirio Díaz, and is in southern end of the "Bassin de Las Esperanzas," and where are situated the mines of the Mexican Coal and Coke Company.

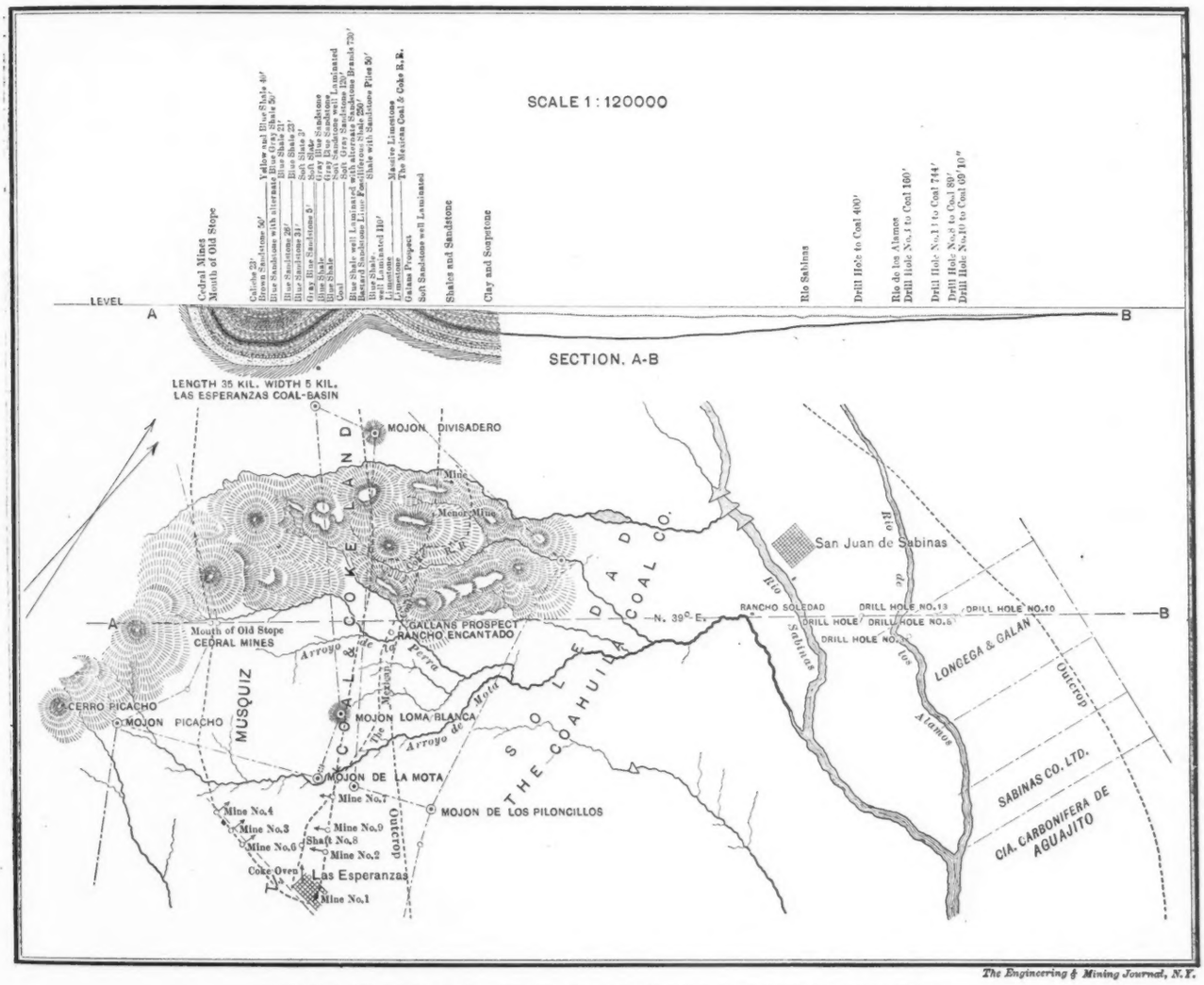
Bassin de Fuente

The Bassin de Fuente, according to the examinations that have been made there, has an area of 5000 hectares. It seems to be a small basin parallel to the coal deposit which extends along the Rio Grande, which is exploited at Eagle Pass and near Laredo, in the state of Texas, and which has been recognized and studied near the town of Mier, in the state of Tamaulipas, Mexico.

The coal of Fuente, although presenting the same general characters as the coals of Eagle Pass and Laredo, contains less carboniferous slate and ash, as shown by the following analyses:

COAL ANALYSES.

	Laredo.	Fuente.	Eagle Pass.
Moisture	3.20	1.40	3.49
Volatile matter	37.35	39.40	36.87
Carbon	39.90	40.20	34.00
Ash	25.55	19.00	25.64
	100.00	100.00	100.00



The Engineering & Mining Journal, N.Y.

MAP AND SECTION OF PORTION OF LAS ESPERANZAS AND SABINAS COAL BASIN

The high proportion of volatile matter gives the Fuente coal a special value for roasting purposes and gas manufacture, and it contains at the same time sufficient carbon to be employed for steam generation.

The coal of this basin is mined by the communication with the main line of railroad by a 10-km. branch, running northeasterly to Las Esperanzas, which is at the

NOTE—A paper read at the session of the International Geological Congress, Mexico, D. F.

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Fuente Coal Company, which has effective and preponderant rights over all these lands, and is allied to the Mexican International railroad.

Sabinas Basin

At the south of the Fuente field the railway crosses the summit line of Teyotes, and then descends into the Sabinas basin, which extends along the Sabinas river. This basin is 55 km. long by 25 km. wide; its general direction is northwest to southeast. The Sabinas coal is entirely different from that of Fuente; it is richer in carbon and consequently better for steaming, as shown by the following analysis:

ANALYSIS OF SABINAS COAL.

Ash	14.60
Carbon	64.20
Volatile matter	21.20
	100.00

If well cleaned the Sabinas coal will give quite a good coke, which is not true of the Fuente coal.

The carboniferous formations of the fields of Sabinas and Las Esperanzas belong to the Upper Cretaceous and correspond to a part of the Laramie formation, in the United States. The great part of the Sabinas basin extends to the west of the river and belongs principally to the Coahuila Coal Company, which is under the predominant influence of the Mexican International railroad.

The Sabinas basin extends over a vast surface; but since it is broken up by faults, which generally are not manifested by any exterior sign, the workable parts in which the coal is thick enough and pure enough to be mined with profit, rarely exceed 500 hectares in a single body, and are separated by great distances in which the coal is too thin, or stratified with too great a proportion of slate or other mineral substances, to have any marketable value whatever.

Under the most favorable conditions, the coal varies from 1.37 to 1.52 m. in thickness, with an interlying seam of shale of from 15 to 30 cm. The lower seam, which lies below the shale, is usually clean, and measures from 0.5 to 0.61 m. The coal which covers the shale, and which is usually about 0.61 m. thick, is more often mixed with ribbons of carboniferous slate, which, not being separated when mined, affect the purity of the coal and increase its proportion of ash when shipped.

The First Coal Development Occurred in 1884

The Sabinas and Las Esperanzas basins are separated by a straight summit line. At the southern end of the former basin, the outcrop crosses the river near the town of San Felipe, at 20 km. south of Sabinas station, and follows the eastern bank. Here was undertaken the first coal-mine development work in Mexico, in 1884. The outcrop again crosses the river, about 5 km. higher up, and follows the western shore to a point at about 2 km. above the bridge of the International railway, where it again crosses the river to the eastern bank, remaining there until it turns south at the upper end of the basin.

The workings at San Felipe proved that the seam dipped slightly, consequently it was opened by shafts sunk in the western bank, in 1887, and the mining center of Hondo was established by the Coahuila Coal Company. The mines Nos. 5, 7 and 8 are still worked. The workings have shown that the ground is broken by faults; a fault 27 m. high has been found between shafts Nos. 2 and 6.

The Coahuila Coal Company

The Coahuila Coal Company is opening mines higher up the river; the first, at Mezquite, where the International railway meets the outcrop on the western side of the river, opposite the town of Sabinas. It is a mine of small importance, intended to supply the locomotives of the Mexican International railway as they pass.

A shaft, called the National, has been sunk at a point 10 km. north and 762 m. from the shore of the Sabinas river. In this shaft the coal was encountered at 260 ft. deep and two seams were found. The upper seam, 1.98 m. thick, is divided by two layers of slate, which reduce the thickness of the coal to 1.22 m. The lower seam is only 1.06 m. thick, but is much cleaner. These two layers are separated at the bottom of the shaft by 2.44 m. of slate, but the development work carried on from this point in the direction of the river, ascending the slope of these two seams, shows that the two beds approach so near together as to be separated only by a layer of slate about 0.61 m. thick; on the contrary, in descending, the seams diverge so much that, in an air shaft 213 mm. away from the principal shaft, they are found separated by 30 m. of hard strata, and in a bore hole 120 m. deep, at more than a kilometer from the same principal shaft, there are 49 m. of strata between them.

Bore holes in the vicinity of this shaft have demonstrated the existence of more than 2000 hectares of workable coal; but the presence of slate and slaty coal renders difficult such a cleaning of the coal as will make it acceptable to the market.

Borings made by B. W. Robinson, manager of the Coahuila Coal Company, have shown that there are vast areas of exploitable coal which may be opened when the demand arises, but a large part of the 80,000 hectares controlled by this company has not yet been explored.

The eastern outcrop of the Sabinas basin crosses the Sabinas river immediately above the town. A triangular tract of about 1600 hectares situated on the eastern shore has recently been opened by the Agujita Coal Company.

A section of the coal seam made in gallery No. 1, in the spring of 1905, has given the following results:

SECTION OF SEAM.

Coal	0.33 m
Slate	0.05 "
Coal	0.25 "
Slate	0.08 "
Coal	0.28 "
Carboniferous slate	0.05 "
Coal	0.38 "
General total	1.42 "
Total of impurities	0.18 "
Net coal	1.24 "

Adjacent to this tract is the domain of W. B. Cloete. Prospecting has been done, but the coal was found so mixed with slate that it was hardly possible to purify it sufficiently for sale. To the north of these holdings, on the two sides of the Rio de los Alamos, and near the village of San Juan de las Sabinas, are the properties of Ernesto Madero and Arturo Longega. They possess a total of 3000 hectares of carboniferous lands; but borings carefully made there have discovered several important faults. They have, nevertheless, a certain area of at least 500 hectares of workable coal, varying from 1.37 to 1.52 m. thick.

A section made in their gallery No. 1 in the spring of 1905 gave:

COAL SECTION NEAR SAN JUAN DE LAS SABINAS.

Coal	0.08 m.
Carboniferous slate	0.05 "
Coal	0.28 "
Slate	0.10 "
Coal	0.41 "
Carboniferous slate	0.05 "
Coal	0.41 "
General total	1.38 "
Total of impurities	0.20 "
Net coal	1.18 "

The upper part of the basin, where it turns, has not yet been studied; the nearest point where investigations have been made is on land held by the Monterey Coal Company. The exploration of these lands has shown the existence of considerable areas rendered valueless by faults; but in the neighborhood of the galleries that are being opened borings have established the existence of about 500 hectares, under which there is nearly 1.52 m. of workable coal.

Las Esperanzas Basin

This basin, which extends parallel to that of Sabinas and is separated from it only by a line of hills of about 3 km., belongs, in great part, to the Mexican Coal and Coke Company, which concern has carefully studied the carboniferous lands in this vicinity, and began mining at the southern extremity of its holdings in the autumn of 1899.

The coal is similar in quality to that of the Sabinas field, but its thickness is double, and in some places reaches a thickness of 6 m., including a 0.3-m. layer of shale, which extends through the middle.

The Esperanzas field is 35 km. long by 5 km. broad. Of this area the Mexican Coal and Coke Company possesses about 8000 hectares. It has established its prin-

cipal working center in the southern part of the field, where the outcrop in turning reduces the inclination of the seam to about 8 deg. The channel of the basin descends with a slope of about 7 deg.; and since the basin does not broaden, the sides become very abrupt in the middle.

Well made borings have, however, shown that the thickness of the seam reaches its maximum at the south end of the basin, where the mines of the Mexican Coal and Coke Company are in operation; while at the upper end of the field, the seam becomes so thin that the borings give it no more than 0.76 to 1.06 m., until it passes south of Múzquiz town. Although faults have been encountered in the workings of this basin, they are not so extensive, and the dislocations are not so great as in the Sabinas basin.

The plan of development of the Mexican Coal and Coke Company has consisted in a series of seven galleries, opened on the two sides of the basin; the coal is clean at the southwestern outcrop, and is opened by galleries 3, 4 and 6, where the seam is perfectly regular and a section gives the following figures:

SECTION OF COAL SEAM.

Coal	0.25 m.
Carboniferous slate	0.05 "
Coal	0.76 "
Shale	0.30 "
Coal	1.06 "
General total	2.42 "
Total impurities	0.36 "
Total coal	2.06 "

In the eastern part of the basin the coal is thicker, but it is neither so regular nor so pure. A section in this district gives:

Coal	0.27 m.
Carboniferous slate	0.06 "
Coal	0.42 "
Parting of pyrite	0.03 "
Coal	0.19 "
Carboniferous slate	0.09 "
Coal	0.30 "
Parting of slate	0.24 "
Coal	0.03 "
Carboniferous slate	0.03 "
Coal	1.03 "
General total	2.69 "
Total coal	2.23 "
Total impurities	0.46 "

The coal in this same eastern part of the basin contains also a soft vein of what the miners call "mother coal." This coal turns into dust and is a serious obstacle in the manufacture of coke. No trace of this "mother coal" is found on the west side of the basin. Experience has shown that on the west side of the basin a coke of superior quality may be made with the fine dust that passes through a screen of ⅛-in. mesh.

The Mexican Coal and Coke Company is the only coke maker in this district. It uses this dust in 226 ovens, which produce a total of 7000 tons of coke per month.

A sample of coal, mined in pit No. 3, according to the rule formulated by the U. S. Geological Survey, and analyzed at its laboratory at the St. Louis, Mo., exposition, 1904, gave the following results:

COAL ANALYSIS.

Moisture	0.42
Volatile matter	21.83
Carbon	69.84
Ash	7.91
	100.00
Sulphur, determined apart	0.70

An average sample of the coke made with coal from these same mines, and taken at the same time, gave:

COKE ANALYSIS.

Moisture	0.14
Volatile matter	0.76
Carbon	85.95
Ash	13.15
	100.00
Sulphur, separately determined	0.74
Phosphorus	0.004

An average sample of the mine, taken near gallery No. 1, more than 1000 m. from the surface and at a point where the seam was 2.69 m. thick, was taken to the Ohio State University and there analyzed by Prof. N. W. Lord, June 29, 1905. The analysis was as follows:

COAL ANALYSIS.

Moisture	0.95
Combustible volatile matter	19.73
Carbon	69.86
Ash	9.45
	100.00
Sulphur, separately determined	0.997
Calorimetric value in British thermal units	13,995

This sample had been taken conformably to the rules laid down for taking "samples of mines," by the U. S. Geological Survey, according to which a V-shaped cutting should be made from top to bottom of the seam. In this cutting are comprised a portion of the small partings of foreign material, less than an inch thick, but not the thicker seams of slate and slaty coal, which may be separated in cleaning.

This Mexican coal, when suitably prepared, gives effectively 14,000 B.t.u., while the different coals of the United States examined at St. Louis in the laboratory of the American Government by Professor Lord, maker of the foregoing analysis, have given the following figures:

HEATING VALUE OF AMERICAN COALS.

	British Thermal Units.
Colorado	9,767
Alabama	12,865
Illinois	12,046
Indiana	11,822
Indian Territory	12,787
Kentucky	12,283
Missouri	10,505
Texas	7,267
West Virginia	13,918 and 14,614

Consequently, if we except the best coal from West Virginia, the Mexican coal, when well prepared, is more than equal to the American coal in heat units—a generally accepted measure of a coal's value—and if it be true that the elimination of the carboniferous slate, a portion of which is intimately mixed with the coal, renders it almost impossible to produce large lumps of this fuel, still this coal has been proved to yield smaller sizes, such as nut, pea, and buckwheat coal, and to furnish a good fuel for Mexican steaming purposes.

A single test was made with measured coal at Monterey, in the works of the American Smelting and Refining Company; this test showed that the smallest of the above grades gave 12,748 British thermal units.

Before the opening of the Mexican Coal and Coke Company's mines at Las Esperanzas, in 1900, the only coal worked was that of the companies in Coahuila, Fuente and Alamo, where the administration is under the influence of the Mexican International railroad, and the products thereof were almost entirely consumed by that line and by the Southern Pacific, then its ally. The Mexican Coal and Coke Company opened Las Esperanzas basin, began shipments July 1, 1900, and pushed work in its coal deposits so far that in 1904 their production reached 512,362 metric tons. The success of this coal company provoked the formation of three others, which probably have commenced to ship coal before this.

The first coal in this part of Mexico was extracted in February, 1884, from the Sabinas coal mines, situated on the west side of the Sabinas river, about 1 km. north of the town of San Felipe.

These mines were worked until July, 1886, and gave a total of 101,000 tons. The operations there were suspended for some time by reason of legal difficulties, but were resumed in January, 1888, the new name of the concern then being Alamos Coal Company, and were continued until September, 1901, at which time they had produced 1,017,000 tons.

The Coahuila Coal Company was organized to work the coal deposit situated in a grazing land belonging to the Mexican International railroad, on the west and south bank of the Sabinas river, and designated the "Domain of Solitude." Operations were commenced at Hondo in January, 1887.

Production of Important Mexican Companies

Working of the basin of Fuente was commenced by the Piedras Negras Coal Company, about the month of November, 1891, and continued to May, 1894. The production was inconsiderable and did not exceed 30,000 tons.

The Fuente Coal Company was then put into possession of this concern's properties and commenced to ship in June, 1894. From this time to December 31, 1904, the products reached a total of 912,000 tons.

The Mexican Coal and Coke Company began its operations in November, 1899; its first shipments of coal were made July 1, 1900, and from this date to December 31, 1904, it shipped 1,656,894 tons.

The above concerns, adding to them the Mexican Steel Company, of Monterey, which has extracted a little coal from a section of the outcrop abandoned by the Alamos Coal Company, are the only ones that have mined coal in Mexico up to this day.

The total coal produced by the deposits in the state of Coahuila up to December 31, 1904, amounted to 5,218,894 tons, and 550,808 tons of coke. The shipments made in 1904 may be summed up thus: Fuente Coal Company, 62,400 tons; Coahuila Coal Company, 256,500 tons; Mexican Coal and Coke Company, 512,862 tons; giving a total for these mines, in 1904, of 831,762 tons. The tonnage of coke the same year reached: For the Coahuila Coal Company, 13,150 tons; for the Mexican Coal and Coke Company, 52,737 tons, making a total of 65,887 tons.

Commercial Conditions

In the northern part of Mexico, which is accessible to the product of these mines, the native coal has almost closed the door against foreign coal. But in the south, where outside products are imported by water, at Tampico and Veracruz, and where reduced rates are allowed by the railways from these ports to the industrial centers, the coal of the country cannot compete with the purer American coals from West Virginia.

The costs of extraction are excessively high in the mines of Coahuila. The roof is weak and must be supported by props; these supports cost dearly, for they must be imported from the United States, the carboniferous zone not producing such trees. Water also occasions considerable expense. In all these mines the entries encounter considerable feeders of water, some permanent, others temporary, and to overcome this problem, powerful, costly pumps have been installed in most of the mines.

It will never be possible to extract the coal of this region at a price so low as in the coalfields of the United States, and it is almost impossible, because of the slate partings mixed in the coal, to produce a commercial fuel with as little ash as in those that come from the purest seams worked in certain parts of the United States. The railways, however, understand the value of Mexican coal lands, and by rate reductions, are aiding the mining companies to extend their developments further toward the interior of Mexico.

There is today a sufficient area known in the region of Coahuila to meet the needs of all Mexico, and with suitable transportation rates, the production of this district may be considerably increased. Last year the extraction was limited only by the demand.

General Geological Conditions

The two fields of Sabinas and Las Esperanzas are the important ones that have actually been explored and proved workable. There are other fields parallel and contiguous to these, belonging to the same geological formations, but the explorations made in them have not hitherto revealed coal areas large enough to be advantageously developed. It is without doubt entirely possible that other fields may be discovered, in which are extensive and workable coal deposits—the geological constitution of the country permits this supposition—but the borings that have been made almost interruptedly for the last three years in adjoining and parallel fields have not yet revealed bodies of coal pure enough or thick enough to pay the cost of extraction.

One of the characteristic marks of the geology of this region is the flow of lava which was produced by the craters of the Santa Rosa mountains, situated west of these fields, and which occurred, as may be observed, a short distance behind the outcroppings. This lava spread in a sheet 1.20 to 3.04 m. thick, and forms a covering of the mountains that rise above these fields. The sides have undergone erosion, so that the shales and sandstones of the carboniferous formations, distinctly appear under this covering of lava; and the lava, being of more recent date, has evidently been deposited after the faulting of the basins with no visible effect upon their formation.

Some of these lava streams have traversed the whole width of Las Esperanzas basin and have covered the Sabinas basin as far as the river. There exist also traces of old craters, which have erupted across the Sabinas basin. The influence which they have exerted upon the neighboring carboniferous formation has not yet been practically determined, the workings of the nearest mines, at Hondo, not having been pushed far enough to show any disturbance due to its action.

The carboniferous territory already examined shows the existence of a body of coal sufficient to furnish a good supply for an unlimited time, and through a modification of slow-speed transportation rates, permitting native coals carried by railways to compete with foreign coals arriving through seaports, Mexico may produce all the fuel necessary for its present and future needs and become completely independent of a supply of coal and coke from abroad.

Rock Temperature at the Witwatersrand

At the annual meeting of the Transvaal Chamber of Mines, Feb. 25, 1909, Lionel Phillips made the following statements:

I thought it would be interesting, as we now have shafts down to a depth of over 4000 ft. vertical, to have some further temperature tests made, and some rather striking results have been obtained. Rock temperatures have been taken in the Cinderella Deep, Knights Deep, Robinson Deep, Simmer Deep, Jupiter and the Brakpan mines. I need not go into details, but may say that the experiments show that the temperature rises at the rate of 1 deg. F. in every 255 ft. of vertical depth. The normal increase of temperature elsewhere in the world, is, I understand, about 1 deg. for every 65 ft. of vertical depth. At the bottom workings of the Brakpan and Jupiter mines, 4400 ft. from the surface, the rock temperature is only 82 deg. F. At the depth of 7000 ft. vertical the temperature at this rate of increase would be between 92 and 93 deg. Fahrenheit.

The present knowledge of the outcrop of the Main Reef series covers a length of over 60 miles. Down to a depth of 7000 ft. vertical the beds would, at an average of the present dip, taken at 30 deg., measure no less than 10,012 ft. on the incline. I dare not make calculation of the life of the mining industry on this basis, but anyone wishing to amuse himself may multiply 60 miles (reduced to feet) by 14,000 ft. and again by a thickness of reef to suit his fancy, say 6 or 8 ft., dividing the product by 13 to produce tons. He will arrive at stupendous figures of the tonnage yet to be worked.

Without venturing to be as sanguine as that, I may say that the present indications point to the probability of mining being continued upon the Rand in the next century. No stronger evidence than this of temperature could be found that mining in the sedimentary deposits of this region is likely to be carried on to a depth far in excess of anything hitherto known in mining. It is a curious thing that the temperature of the earth here appears to rise in depth so much less rapidly than elsewhere in the world.

Mexico holds the fifth position in the production of quicksilver in the world but falls short by a considerable amount of producing enough to supply the home market. Prior to the introduction of the cyanide process for the treatment of the silver ores the importations of quicksilver, known in the Spanish as *azogue*, was very heavy and the necessity of having this metal for the patio process was so great that the government removed all taxes from quicksilver mining, both federal and state, and provided for the free admission of quicksilver into the country. This same law is enforced today and is one of the causes stimulating the new developments in the Mexico quicksilver districts. The falling off of production in other parts of the world has turned attention to the Mexican districts and the prospects of greater activity in quicksilver mining in Mexico are very good.

It is reported by U. S. Consul Thomas W. Voetter, Saltillo, Mex., that since the imposition of the duty on zinc ore imported into the United States producers of these ores in Mexico are considering shipping to other countries. Claims are made that such ores may be profitably shipped to Germany and already some shipments have been made.

Important States of Central and Southern Mexico

Review of an Interesting Part of the Republic Covered in the Accompanying Maps Compiled from the Most Recent Data Obtainable

BY H. A. HORSFALL*

The two sketch maps reproduced herewith show sections of Mexico which, at the present time, are commanding the attention of capitalists seeking investments in profitable new enterprises. In the map of a part of central Mexico is shown the state of Jalisco in which the mines are being exploited in a constantly increasing degree. The mines of this state were worked extensively by the early Spaniards, and tradition recounts many bonanzas having been encountered in the early days of Spanish possession. The change in the character of the ore as depth was obtained, the depreciation in the value of silver, the presence of considerable quantities of water in the lower levels, the absence of transportation facilities and, lastly, the increased cost of labor are causes which resulted in the abandonment of many mines. This has been largely changed during the last few years owing to increase of transportation facilities and improved methods of ore reduction. Today a greatly increased activity, with the investment of a large amount of new capital, is taking place.

Gaudalajara, the capital of the state of Jalisco, is a beautiful city with wide streets and shaded avenues, and is surrounded on the south and west by an extensive agricultural area. It is the second city in the Republic in population and is a place of manufactures. With large banking and mercantile facilities, it has become the central point for the control of mining operations covering a large area.

Jalisco Mining Districts

The principal mining district of Jalisco lies a few miles north of the town of Hostotipaquillo, on the south bank of the Santiago river. In this vicinity, the river has cut through and exposed the formation for a length of over 30 miles. The mines of the Hostotipaquillo district contain large quantities of milling ores of which silver and gold are the valuable minerals. Most of the mines were *antiguas* and have recently been largely worked for the development of the lower-grade orebodies. A number of modern mills are being constructed and several of them are nearly ready to operate. The high-grade ore is shipped to the smelteries at Aguascalientes, and other points.

Copper ores are found and are being actively developed in the Etzatlan, Ameca, Autlan and other districts; copper-reduction plants are in operation at Ayutla and near Ameca. Extensive deposits of iron ore are found in several places; at Tula, in the southern part of the state, iron furnaces have been operated for many years. Coal, a semi-anthracite of good quality, is also being exploited. The deposit is in the southeastern part of the state, 18 miles east of Zapotlan station on the Manzanillo branch of the Mexican Central Railway.

The Santiago river, known in Mexico as El Rio Grande de Santiago, is the largest and longest river lying wholly in the Republic. It is said to have a total length of nearly 800 miles and is divided at about the middle of its course into two nearly equal parts by Lake Chapala, a beautiful sheet of water 70 miles long and 20 miles wide. The surface of the water in the lake is 5159 ft. above sea level. The upper portion of the Santiago river is called the Rio Lerma. Its headwaters are a few miles southeast of Toluca, in the state of Mexico; it flows north until it reaches the 20th degree of north latitude; thence it runs in a general westerly direction with many twists and turns until it empties into the eastern end of Lake Chapala.

Santiago River Power Development

The river leaves the lake on its northern side a few miles northwest of its point of entrance, flows north a short distance, then westerly, nearly paralleling the north shore of the lake, from which it is separated by a low range of mountains, thence it takes a northwesterly course. At the falls of Juanaca, about 15 miles southeast of Guadalajara, the river enters a deep cañon; at this point it makes a single drop of nearly 100 ft., forming an immense cascade. It continues to fall very rapidly for about 15 miles to Las Juntas, the total drop being over 1800 ft. A company has been formed to construct a canal along one side of the gorge, and convert the water power into electricity, which will be distributed by high-tension lines to nearby and distant mining centers. It is also intended to furnish power to the Lake Chapala district, to elevate water for irrigation. The river continues in a northwest direction to 20 deg. 50 min., north latitude, where it turns west and runs to the Pacific ocean. The area drained by the Santiago river is approximately 60,000 square miles.

In the territory of Tepic, there is considerable activity in mining at the present time. A few mines are producing, many more are being developed and a number have commenced the construction of mills. The Southern Pacific railroad has entered the territory with its construction work and the rails are laid to a point about 22 miles north of the Santiago river. It is expected that the road will be in operation, from Mazatlan to the Santiago river, some time during the present year. Some of the principal mining districts are Acaponeta, Tepic, Compostela, Ixtlan del Rio, Santa Maria del Oro, and Amatlan de Cañas.

Agricultural Sections

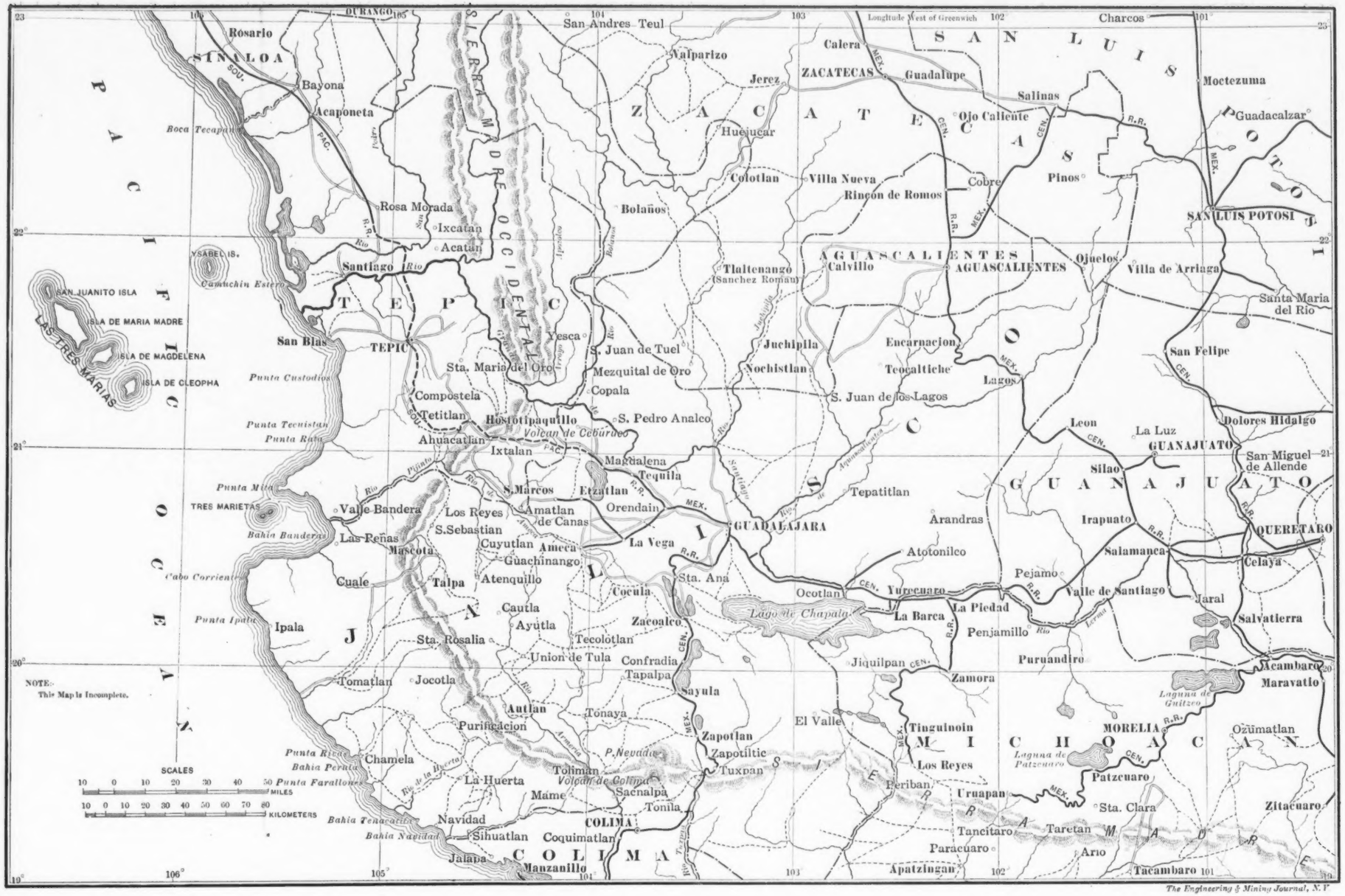
The state of Colima is principally devoted to agriculture. The port of Manzanillo, on the Pacific, is the terminus of a branch of the Mexican Central Railway and promises to become an important place, as the Mexican government has spent a large amount of money in dredging the harbor and constructing piers. On the northern boundary where it adjoins the state of Jalisco is situated the active volcano of Colima.

Owing to the absence of transportation facilities the state of Michoacan is not especially prominent in a mining way; it is, however, one of the leading states of the Republic in the production of agricultural products. The principal mining district is Tlalpujahua, situated in the extreme northeastern part of the state; it adjoins the El Oro district, which is situated in the state of Mexico. Other districts are the Sunda, 25 miles east of Morelia, Ario de Rosales, Zitacuaro, Carrizal de Arteaga and Tacambaro. There are a number of mines in the southern part of the state along the Balsas river, which do not come within the limits of the map.

There are many other mining camps situated within the limits of this map in the states of Zacatecas, San Luis Potosi, Aguascalientes and Guanajuato; want of space, however, precludes their enumeration.

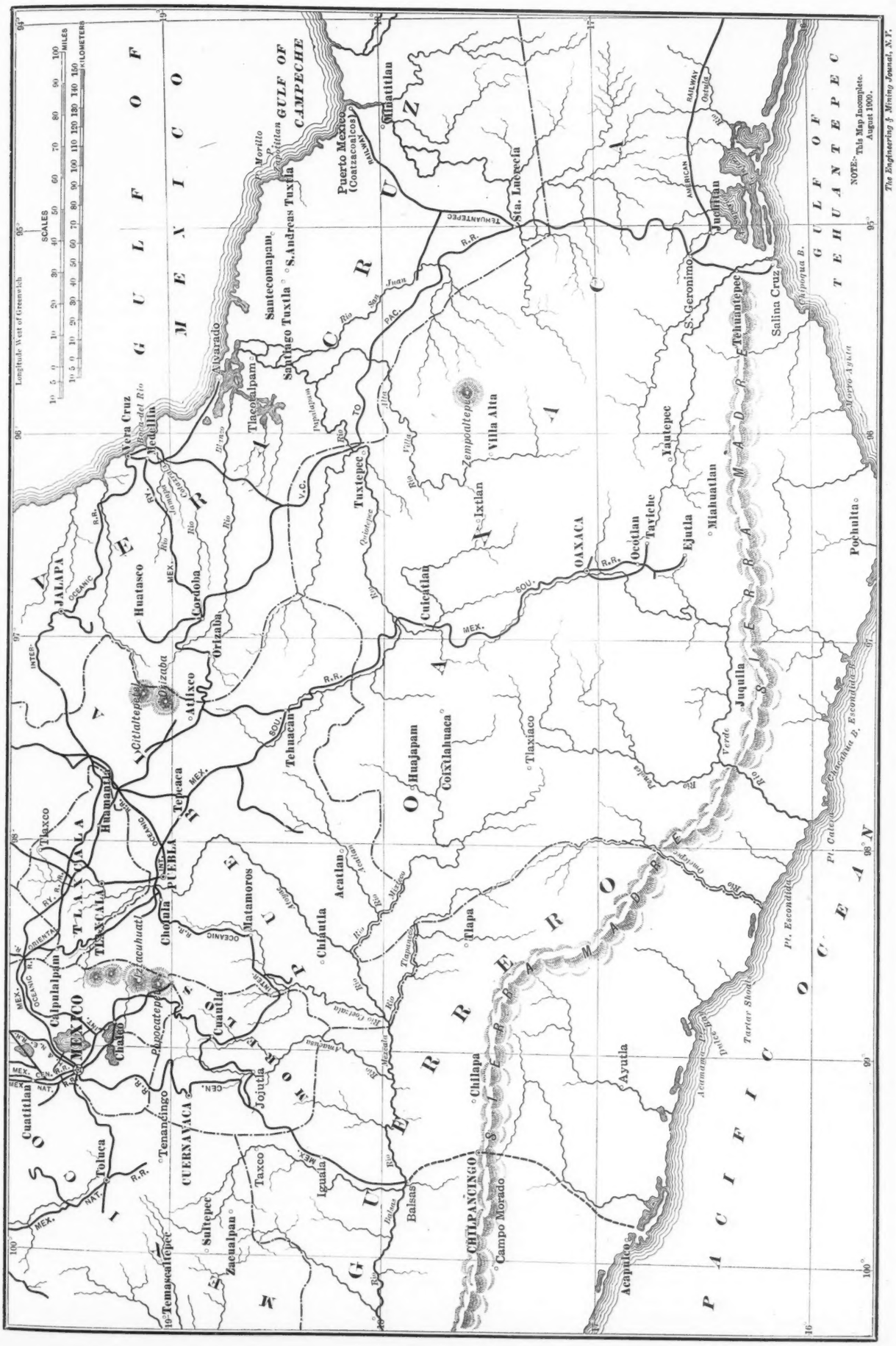
State of Mexico

In the map of a part of southern Mexico is shown the location of the City of Mexico, the capital of the Republic; it is an attractive city with a population of over 400,000 and is situated in a beautiful valley at an elevation of 7350 ft. The principal mining camp in the state of Mexico is situated in the northeastern part of the state and is known as



MAP OF A PART OF CENTRAL MEXICO

Compiled by H. A. Horsfall.


GULF OF MEXICO
CAMPECHE
GULF OF TEHUANTEPEC
PACIFIC OCEAN
SIERRA MADRE
SIERRA MADRE DEL SUR
MESA CENTRAL
Longitude West of Greenwich
SCALES
MILES
KILOMETERS
Veracruz
Jalapa
Orizaba
Córdoba
Huatusco
Tlacotalpam
Alvarado
Santiago Tuxtla
S. Andreas Tuxtla
Santecomapam
Puerto Mexico
(Coatzacoalcos)
Minatitlan
Sta. Lucrecia
Jaltipan
Tuxtepec
Cuicatlan
Ixtlan
Villa Alta
Zempoaltepec
Oaxaca
Ocotlan
Tarifche
Ejutla
Miahuatlan
Tlahuitoltepec
Juquila
Juquila Mixes
Yautepec
S. Geronimo
Tehuantepec
Salina Cruz
Chivela P.
Pochulta
Mogro Ayuta
Tehuacan
Coixtlahuaca
Huajapam
Tlaxiaco
Acatlan
Chiautla
Matamoros
Izucar
Atlixco
Puebla
Tlaxcala
Apizaco
Chalco
Mexico
Cuautitlan
Toluca
Tenancingo
Cuernavaca
Jojutla
Cuautla
Iguala
Taxco
Zacualpan
Sultepec
Temascaltepec
Chilapa
Tlapa
Ayutla
Acapulco
Campo Morado
Balsas
Chilpancingo
Pt. Escondida
Tartar Shoal
Pt. Cahuana
Pt. Escondida
Acrimanga
Puerto Angel
Morro Ayuta
Chipinqua B.
Rio Verde
Rio Papaloapan
Rio Tepalcatepec
Rio Mexcala
Rio Balsas
Rio Atoyac
Rio Zahuapan
Rio Tlapacoya
Rio Papagayo
Rio Tonto
Rio Vinta
Rio Quiotepec
Rio Jamapa
Rio Blanco
Rio Metlac
Rio Coatzacoalcos
Rio Jaltepec
Rio Sta. Juan
Rio Tehuantepec
Rio Chivela
Rio Tequisistlan
Rio Tonala
Rio Cuilapa
Rio Cuautla
Rio Amacuzac
Rio Cuernavaca
Rio Tenancingo
Rio Chalco
Rio Tlalmanalco
Rio Cuautitlan
Rio Toluca
Rio Temascaltepec
Rio Zacualpan
Rio Taxco
Rio Iguala
Rio Jojutla
Rio Cuautla
Rio Amacuzac
Rio Tenancingo
Rio Chalco
Rio Tlalmanalco
Rio Cuautitlan
Rio Toluca
Rio Temascaltepec
Rio Zacualpan
Rio Taxco
Rio Iguala
Rio Jojutla
Rio Cuautla
Rio Amacuzac
Rio Cuernavaca

El Oro; it is a large producer of gold and in connection with recent improved methods introduced into its cyanide plants has attained a world-wide reputation. Other prominent mining camps in the southern part of the state are: Zacualpan, Sultepec and Temascaltepec.

The mines of Taxco, said to be the place where silver was first discovered and worked by the Spaniards in the time of the conquest, are situated in the northern part of the state of Guerrero, along the Balsas river. East and west of the Mexican railroad are several producing mining camps. Campo Morado, situated about 45 miles southwest of Balsas station, has large deposits which are now being worked extensively. There are many other localities where valuable minerals are known to exist. The country is very broken and has large areas in the central part that are entirely unprospected, and of which little is known. During the latter part of July this section was visited by a destructive earthquake. Many buildings in the towns of Acapulco, the seaport on the Pacific coast, and Chilpancingo, the capital city, were destroyed.

Diverse Resources of Oaxaca

The state of Oaxaca is now claiming considerable attention from mining investors. It was one of the earliest Spanish settlements in Mexico. Many of its mines were worked with much profit in the early days. Of late years, owing to its remoteness from lines of travel, its possibilities have been overlooked until very recently. At present a large amount of work is being done in the opening up of old properties, and prospecting for new mines. The principal producing mines are situated in the vicinity of the city of Oaxaca near the towns of Ocotlan, Taviche, San Jose, Zimatlan, Tlacolula and Ejutla. Coal and iron deposits are found in the northern part of the state in the vicinity of Huajapan. In the southern part of the state near the Pacific coast, petroleum deposits are being exploited.

The state of Puebla has few notable producing mining districts, Acatlan in the southern part and Teziutlan in the northeastern part of the state being the principal producers. A few miles from the town of Teziutlan is the extensive smelting works of the Teziutlan Copper Company.

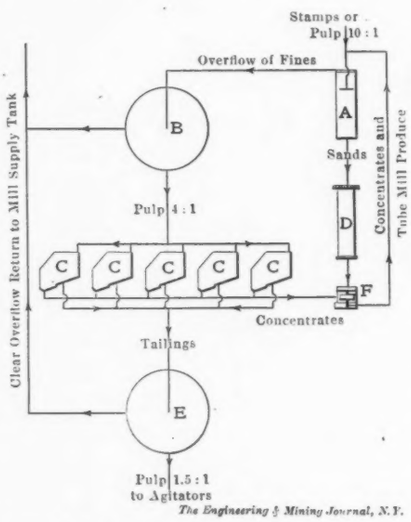
The maps presented herewith have been compiled from the most recent data obtainable, consisting of astronomic observations for latitude and longitude of the principal cities and towns, as published by the Mexican government, charts of the coast lines, location survey maps of the several railroad lines and state maps and present additional data not heretofore published.

Notes on the Cyanide Treatment of Concentrates *

By A. Grothe†

Concentration before cyaniding has the double object of removing cyanicides from the ores, and of obtaining part of the valuable contents of the ore in a form in which it can be sold without any further treatment. This paper is more particularly intended to study the circumstances connected with the second of these two objects.

Ores which have not previously been concentrated require a longer treatment by cyanide and the extraction falls short of that obtained from pulp from which the concentrates have been removed. This is due to the circumstance that the concentrated particles, on account of their greater hardness, have not been reduced to a sufficient state of fineness, consequently requiring a longer period of contact



ARRANGEMENT SUGGESTED BY F. C. BROWN

with the solutions, so that the action is not only retarded, but re-precipitation can easily take place. This can only be overcome by strengthening the cyanide solution during the process, otherwise the extraction will be lessened and the consumption of cyanide increased. A part of the gold and silver is generally incased in the crystals of pyrites, and receives no treatment at all unless the latter have been reduced to a fine state of division; for this reason previous concentration is to be recommended even for the cleanest and least refractory ores.

Mills favorably situated in regard to smelteries generally sell their concentrates to these direct, but those situated at some distance from the railroad work under a disadvantage in this respect, while to the danger of loss in transit is added the usual difficulty of agreeing with the smelter as to weight, moisture and contents. Many mills, therefore, can only ship their richest concentrates, and all suffer from their inability to obtain the contents of the ore in some more convenient form. This consideration and the wish to become independent of the smelteries, have induced many mill operators to adopt a system for the local treatment of their concentrates, in which the first step consists of thorough regrinding, followed by agitation, either with ordinary cyanide solutions, or with the addition of other chemicals which are supposed to accelerate and intensify the action. In this manner the Goldfield Consolidated Mines Company of Nevada treats its concentrates in three tanks of the "Pachuca" type, with satisfactory results. At the mill of the Batopilas Company of Chihuahua, the same method is employed.

Experience with Silver Sulphide Concentrates

With silver sulphide concentrates containing 13,422 grams Ag and 365 grams Au, M. J. B. Empson adopted the following scheme: After regrinding to 200 mesh the material was agitated 72 hours in 1.56 per cent. cyanide solution with a plentiful supply of air. The extraction was 96.7 and 98 per cent. respectively, the consumption of cyanide being 6.9 kg. per ton. During the last 12 hours there was no increase of extraction and probably some reprecipitation had taken place.

The difference between these concentrates and the valuable metal in the tailings from which they had been derived was simply physical and not chemical, and they should therefore be equally amenable to cyanide treatment provided they had been reduced to the same degree of fineness, possibly to 1000 mesh. This fine grinding constitutes the chief difficulty in this treatment; if the concentrates are ground by themselves they pack in the mill, and the result is unsatisfactory; grinding them together with coarse sands obviates this difficulty but even then it is not possible to make sure that the desired degree of fineness has been attained, as the separation by screens or overflow is not delicate enough.

Concentration as an Aid to Fine Grinding

F. C. Brown of the Waihi Grand Junction mine in New Zealand, who has proved himself an earnest and successful investigator of cyanide problems, made a communication to me which seems well worth the notice of mill operators. For some time past he has returned his concentrates to the tube mills, mixing them with the ordinary pulp, and grinding them until they are so fine that they do not settle on the tables but float off with

*A paper read before the Mexican Institute of Mining and Metallurgy, July 12, 1909.
†Mining engineer, Mexico, D. F.

the tailings. In this system coarse concentration has no place, seeing that the object is not to recover the contents of the ore, but simply to use the concentration as an aid to fine grinding. He then goes on to suggest the following arrangement, illustrated in the accompanying diagram, for the convenient carrying out of this idea:

The ground pulp from stamps or mills, containing about 10 of solution to 1 of ore, goes to a "Dorr" classifier *A*, the overflow from which is condensed in the pulp thickener *B* to 4 to 1, or any other proportion suitable to the kind of slime tables used. This overflow consists of particles all passing 150 mesh, only a small percentage being retained on 200 mesh.

The coarser part of the pulp, constituting the underflow of the classifier, goes to the tube mill, or other regrinder, with the proper degree of moisture to obtain the best grinding results. It contains the sands from which the metal has not yet been completely liberated, the pyrites, and the coarser particles of silver sulphides and gold.

The overflow of the classifier, after having been properly thickened in *B*, is concentrated on slime tables *C*. The concentrates from these tables, instead of being sacked and sold as usual, are returned to the pump *F*, joined to the tube-mill discharge, and with these enter the classifier again.

It will be seen that the concentrates are thus kept in circulation until they are so fine that they will not settle on the tables but float off by surface tension and are then carried with the tailings to the second pulp thickener *E*, which produces the proper density of pulp for treatment by cyanide in agitation vats.

The fineness of these concentrates, which after repeated grindings, at last pass off with the tailings, surpasses of course anything that can be separated by the finest screens or by the overflow from cones or classifiers. In this state they will behave exactly as the metals in the ordinary pulp; the extraction will be completed in 24 hours or less; there will be no reprecipitation, and the consumption of cyanide will be in proportion to the metallic contents of the ore.

Possible Objections to the Scheme

The objection might be raised that an accumulation of concentrates will take place on the tables, and that additional work will be thrown on the tube mills. Both are no doubt correct to a certain extent, but as to the first, accumulation will not proceed indefinitely, because, as more particles are presented to the grinding apparatus, a greater effect will be produced, and after a short time a state of equilibrium will be established and the quantity of fine concentrates flowing off the tables will equal that of the coarse concentrates contained in the ore. As to the extra work thrown on the tube mills, this cannot be correctly estimated, but supposing the ore to contain 2 per cent. of concentratable matter, which thus requires regrinding, and that it were necessary to pass it 5 times through the mill before it is fine enough, then the loss of the capacity of the tube mill would be 10 per cent. The additional cost for regrinding would therefore be insignificant when compared to that of disposing of the concentrates to the smelter or subjecting them to a special treatment.

A further advantage of the system is that the action of the solution on the concentrates passing several times through the tube mill is considerable, and shortens the time necessary for agitation. It can easily be tried and its economic value for every case determined, in any existing mill, without making important changes or the addition of expensive plant.

Labor Troubles in the British Coal Industry

Special Correspondence

On two occasions during the present year the coal trade of Great Britain has been threatened with a serious crisis on account of disputes between the owners and the miners on the subject of wages. In the first case the trouble was in South Wales, the friction arising out of the coming into force on July 1 of the act limiting the hours of the labor to eight. In this case a general lockout or strike was only averted at the last minute. The second occasion on which a crisis arose was in July, when the trouble centered in the Scotch coal-mining districts. The dispute in this case was on a question of wages and the interpretation of certain agreements and was not directly due to the eight-hours act. Happily this dispute, like that in South Wales, was also adjusted, but only at the eleventh hour and a disastrous struggle, into which other colliery districts would have been drawn, averted.

The peace, which the settlement of these two grave disputes seemed to have secured, has now again been threatened. In South Wales a serious situation has arisen, owing to difficulties created by the eight-hours act. In a communication to *The London Times* of Sept. 17, the causes of the trouble have been well described by one evidently well informed. It appears that the act hits the collieries in South Wales more than in other districts of England and Scotland, on account of the longer hours worked, previous to the passing of the act.

In South Wales the average working day for six days' labor in each week was about 9¾ hours. The average bank-to-bank day for the rest of the country was a little under 8¾ hours. In Scotland an eight-hour day had practically been the custom for many years and in Northumberland and Durham the average has only exceeded eight hours by a few minutes. The effect of the passing of the act in South Wales has been to reduce the time service per day by 18 per cent. while in the rest of the country the reduction averages only 8 per cent. Since the act was passed the output of the collieries in South Wales has declined from 10 to 20 per cent., and the working costs have increased from 6d. to 1s. 6d. per ton. In order to counteract the burden imposed on the coal owners by these altered conditions new methods of working the pits have been proposed and it is on this point that differences of opinion have arisen between the owners and the miners.

One of the most important changes proposed by the owners is the establishment of the double-shift system, which has been in successful operation in the collieries in the North of England. Under this system an afternoon shift is established, involving the employment of about 10 per cent. of the number of men employed at a colliery, to clear away the coal left over from the morning shift. The pay for this shift offered by the owners is the ordinary pay of the morning shift, but the miners will not accept this rate, demanding exemption from the second shift on Saturday and claiming six days' pay for five days' work.

This is how the matter stands. Neither side will give way and there is a prospect of a lockout on Oct. 31 at those collieries where the afternoon shift is in dispute. The South Wales Miners' Federation has intimated that the quarrel of individual collieries will be supported by the miners generally, and that further support will be asked from the Miners' Federation of Great Britain, thereby threatening a general crisis in the coal trade throughout the country.

Correction

The article on page 199 of the Journal of July 31, 1909, entitled "Zinc Dust Precipitation at the Homestake Mine" was erroneously credited to Robert Linton instead of to T. Lane Carter, who presented the matter as a discussion of Mr. Linton's paper, before the Chemical, Metallurgical and Mining Society of South Africa on the subject, "Zinc Dust Precipitation at Cerro Prieto."

The Mexican mines are finding it advantageous to offer a premium for continuous work during the month. This method is resorted to to overcome the numerous holidays to which the Mexican is prone.

Santa Gertrudis and La Blanca Mines, Pachuca, Mexico

The Santa Gertrudis and La Blanca mines, together with the Barron mine, belonging to the Real del Monte & Pachuca Company, are on an isolated vein in the southeastern part of the Pachuca district in the State of Hidalgo, Mexico. The vein was not developed by the colonial miners as it showed no silver or gold at the surface and was not apparently conntcted with any of the proved veins of the Pachuca district which lies to the east about two miles. About 50 years ago, local companies undertook the prospecting of the vein and at a depth of 600 feet found pay ore which developed into large and very rich orebodies. The first two mines have been continuously worked by local companies to the present time.

The Barron passed to the control of the United States Smelting, Refining and Mining Company through the purchase of the Real del Monte & Pachuca Company, about five years ago, and is now being extensively operated and is one of the best paying mines in the district.

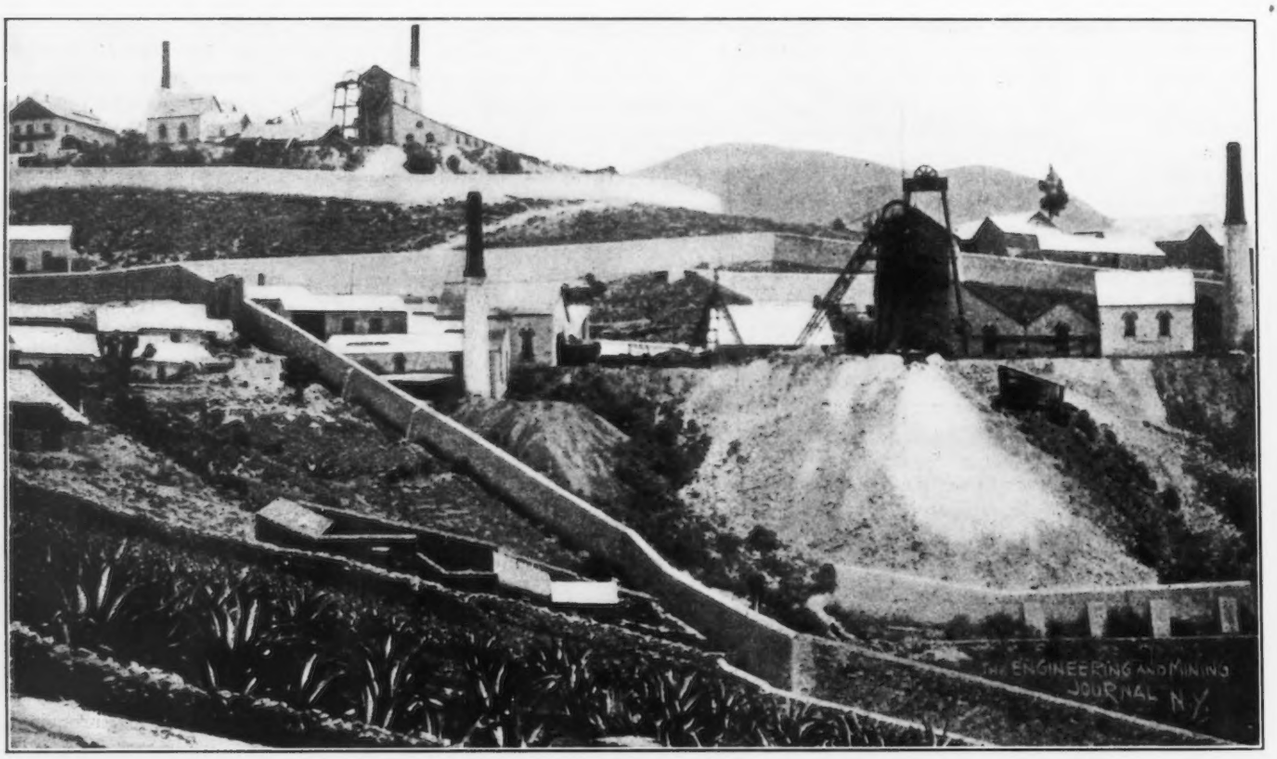
La Blanca mine is in charge of Capt. Francisco Rule, one of the English pioneers of the district, and for many years has been paying monthly dividends of $25,000 on the capital of 12,500 shares of a par value of 200 pesos. This mine is equipped with 14 chilean mills, Johnston concentrators and electric power. Much of the ore is shipped to the Mexican smelteries. Formerly it was shipped to Europe. The company employs about 2000 men.

Santa Gertrudis Uses Patio Process and Pan Amalgamation

The Santa Gertrudis mine also belongs to a Mexican company, Compañia de Santa Gertrudis y Guadalupe S. A., which has a capital of 6,000,000 pesos, divided into 60,000 shares. The mine has paid several millions in dividends. Sr. Jose de Landero y Cos is president. The company owns 243 hectares and has two reduction plants, one equipped with the Boss system of amalgamation and another using the patio process. The patio plant has a capacity of 2000 tons weekly. Recently the company has let a contract for a modern cyanide mill of 300 tons daily capacity. Electrical power is used in mine and mills. There are five shafts, the deepest of which is about 500 meters. The bonanza ore is shipped to the smelteries in Mexico or to Europe.

The ore in these mines is chiefly silver from 1 kg. upward in content and carrying from 5 to 6 grams of gold to the kilogram of silver. In the Santa Gertrudis the gold content is in one vein very high.

La Blanca and Santa Gertrudis are now under negotiation to an English syndicate for a large price, said to be 14,000,000 pesos for both mines. In the case of the Santa Gertrudis a contract to purchase has recently been closed and the property will doubtless be sold to the Camp Bird company.



SAN GUILLERMO AND SAN FRANCISCO SHAFTS, COMPANIA DE SANTA GERTRUDIS Y GUADALUPE, NEAR PACHUCA

The Zacualpan District, Mexico

By James M. Platt*

The old silver camp Zacualpan is in the southeast corner of the State of Mexico, latitude 18 deg. 41 min. N., near the boundary of Guerrero, and midway between Sultepec, Mex., and Taxco, Gro., also historic camps.

Fourteen Hours from a Railroad

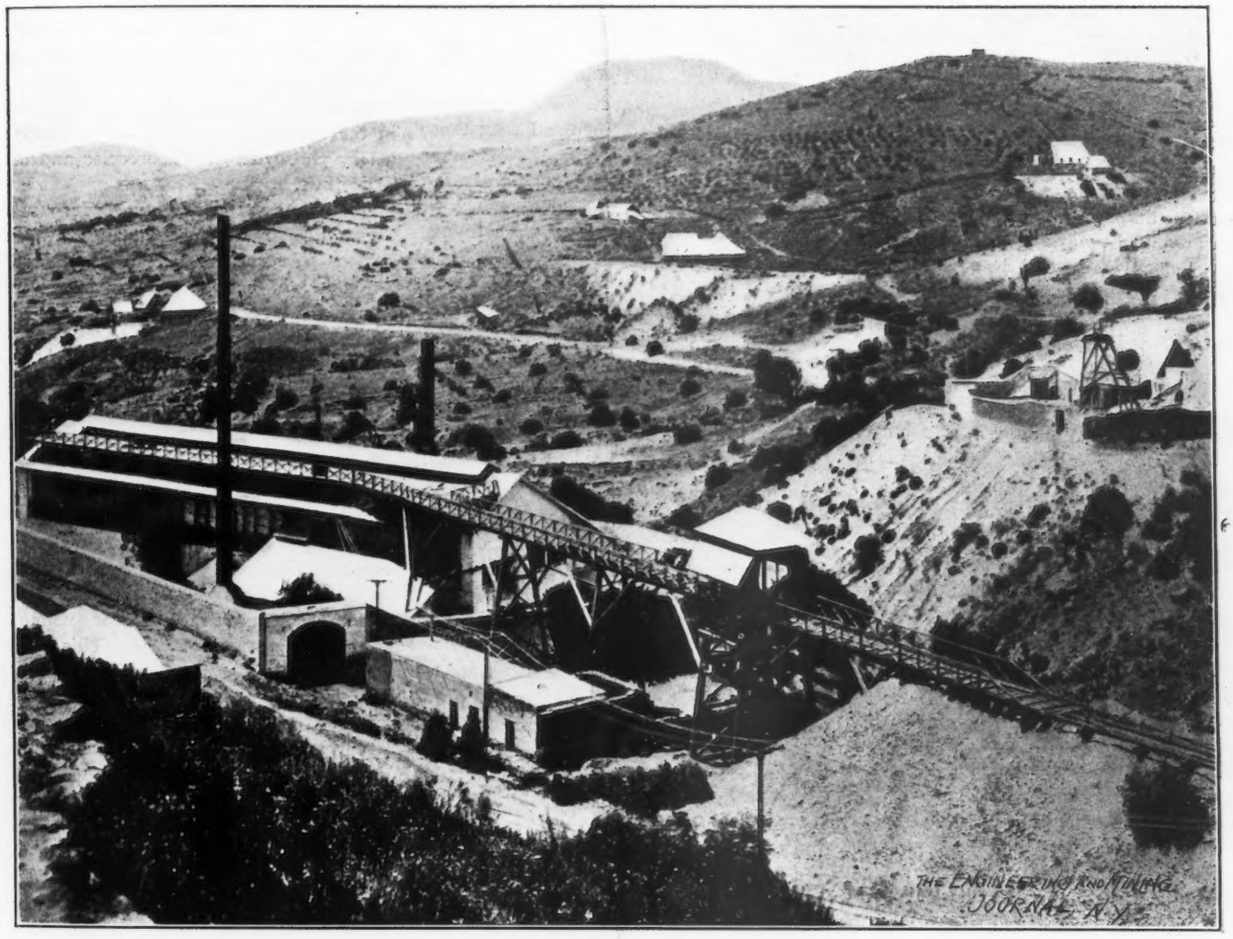
From ten to fourteen hours' steady horseback riding is necessary between Zacualpan and the railroad. Three routes are used; from Naranjo, a station on the southern branch of the Mexican Central, thence coming by Taxco, Gro.; from Tenango del Valle, near Toluca, coming by Malinaltenango; and from San Juan de las Huertas, via Sultepec. A coach has come to Zacualpan from San Juan, but horseback riding is much more comfortable. Supplies are packed in by mules and burros, and heavy machinery is brought on two-wheeled carts. Ore is packed out, either to the smeltery at Los Arcos, eighteen miles north, or to the railroad for shipment to San Luis Potosi, Aguascalientes or Monterey. The country is deeply cut by V-shaped barrancas, and the trails follow mountain ridges.

Several engineers have classified the

*Superintendent, Guadalupe Arcos, Zacualpan, Est. de Mexico, Mexico.

heavily bedded "somewhat calcareous" shales of this district as Middle Cretaceous. In the entire absence of fossils it is impossible to form any judgment except by analogy. I have observed but one isolated occurrence of a distinct porphyry in the district, and this apparently had no influence on ore deposition. The shales are carbonaceous, and the ore black. In the northeast section of the district, in the mines of the Los Arcos Smelting and Mining Company, the rock is more silicious and white to gray-green in color, though on the north border of the district the black shales are very heavily developed.

Ore deposition seems to have been effected by two main causes, the precipitative action upon ascending orebearing solutions of the organic matter in the shales; and the interaction of mingling solutions from intersecting or joining fractures. The latter condition, aided by the former, produces the result, observed in many cases, that the widest portions of the veins, usually at junctures, are very likely to be much richer than the narrower portions. The orebodies are lenticular in form and irregular, as is to be expected from the country rock. In the western section of the district, as in the Coronas and Carboncillo mines, the



REDUCTION PLANT OF COMPANIA GERTRUDIS Y GUADALUPE

Fissure veins and also replacements along shear zones are encountered, and the gangue is usually quartz. The most notable exception as regards gangue is on the south border of the district in the Chontalpa mine, where a calcite gangue is found in an extensive shear zone. That some veins are true fissures is unquestionable. In a vein in Guadalupe Arcos a piece of wood was found embedded at a depth of 150 m. Faults with horizontal displacement across the strike of veins seem to be notably absent, but great vertical movement has taken place along the fault planes.

veins are more regular in dip. The veins are very much more regular in strike than in dip, and rolls in the dip are common. In the northeast portion of the district the varying dip seems to have had little effect on ore deposition.

The ores of the district are stephanite, pyrargyrite, argentiferous lead in small quantity, and pyrite which sometimes carries precious metals. No mines have commercial amounts of zinc and few have enough to affect treatment charges.

The low-grade ores of the camp are usually well adapted to cyaniding, but as yet only one mill is running in camp and all over 2.5 kg. is shipped to the smelteries.

Miners earn from sixty-two centavos to a peso per day, and are somewhat inefficient. In Guadalupe Arcos three hundred meters of development was put through rock of varying hardness, at an average contract price of fourteen pesos per meter. The prices range from eight to thirty-five pesos per meter, contractors buying their own caps, fuse and dynamite, native oil for their lamps, and moving muck from fifteen to eighty meters in baskets. An ordinary wheelbarrow laid down here costs about twenty-four pesos. Average dynamite consumption is about 8.5 lb. per meter, of 40 per cent. powder (native).

As usual in old districts of Mexico, there are only accidental ore reserves in the camp. The future depends on development in both old and new mines. As far as known the deepest working in camp is approximately three hundred meters, on a fissure vein. At that depth the ore still holds in width and the average value in the mine continues. Pumping is not expected to be a serious problem.

In general the outlook is encouraging, and judicious investment after technical investigation promises good returns.

Geologic Study of the Sierra of Guanajuato

The Veta Madre and other Argentiferous Deposits Occur as Brecciated Veins Deposited in Pre-existing Cavities in Fracture Zones

VEINS ARE IN UPPER NEOCENE

The city of Guanajuato, the capital of the state of the same name, is situated 1993 m. above sea level. The part of the sierra richest in minerals extends from the city 11.3 km. north, 3.7 south, 8 east and 9 west. Silver was discovered in the sierra as long ago as 1548, the San Bernabé mine resulting from the discovery of muleteers *en route* to Zacatecas. The Veta Madre was found in 1550 by the muleteer, Juan de Rayas, who gave his name to the Rayas mine. The precious-metal production of Guanajuato from 1701 to 1800 was 279,690,689 pesos, being about one-quarter of the total Mexican output; from 1800 to 1900 it amounted to 231,137,013 pesos. Signs of past grandeur are to be noted in the old structures of the district.

Physiography.

The state of Guanajuato is crossed by two high mountain ranges. One, the Sierra Gorda, lies mainly in the northeastern part. The other, the Sierra de Guanajuato, extends in the central part from southeast to northwest. North of this sierra rise the mountains of San Pedro and El Cubo, which, with the Sierra Gorda, bound on the north the great plains of Allende, Dolores Hidalgo and San Filipe. In the region south and west of the sierra of Guanajuato is El Bajío, a vast and rich plain limited at the south by the mountains of Pénjamo, the Beata and the Gabia.

The foothills of the sierra are lost in the great plains which surround it. In the different directions are important peaks among which are some that are from 2000 to 3000 m. high. Deep ravines and narrow defiles are common. In going from Silao to Marfil, the traveler has before him the southeastern part of the sierra of Guanajuato, which is the richest in valuable minerals. He may easily distinguish the profile of this group of mountains, with tops apparently one above another, giving an idea of steps ascending from the escarped walls of the Grandes Bufas toward the high peaks of the sierra of Santa Rosa. One perceives also the structures of Valenciana and Rayas as well as those of Cerros de Sirena and Chichíndaro; one can thus form an idea of the length and situation of the famous Veta Madre.

NOTE—Abstract of a paper presented in French before the International Geological Congress by J. D. Villarello, T. Flores and R. Robles.

The literature of Guanajuato geology is voluminous and begins with Humboldt, in 1827. One of the noteworthy modern contributions[1] was that of Robert T. Hill, who in addition to other observations, classified the volcanic rocks. Our own study of the Sierra of Guanajuato has led to the conclusions presented herewith.

Schists.

The oldest sediments, which in petrographic character are identical with those of Zacatecas, are argillaceous and other schists and calcareous conglomerates. The argillaceous schists, carbonaceous in several places, were in other places metamorphosed by igneous rocks, but the absence of fossils in these sediments leaves their age uncertain.

The sediments that we have mentioned outcrop at *el bajo* of the Veta Madre, from Peñafiel to Valenciana.

At the surface the schists are sericitic, and of varying color, being greenish-yellow, grayish, and sometimes red. We occasionally find thin strata of bluish gray limestone intercalated.

In the metamorphic schists are also found intercalated strata of calcareous conglomerate, known locally as *frijolillo*, and which crops out in the gorge of the Calera and elsewhere. The argilo-calcareous schists, black and carbonaceous, divide into thin leaves, which fact has occasioned the native name *hoja de libro*, or leaf of a book. These black schists are found under ground, especially in *el bajo* of the Veta Madre, and appear at the surface in the gorges of Calera and Jolula. The metamorphic schists were observed under the black schists by Humboldt in the principal shaft of Valenciana, which is the deepest vertical cut, 535 m., in the locality.

This enormous mass of schists is extremely wrinkled and forms little folds, variable in direction, but inclined toward the west, and the metamorphic schist, according to microscopic examinations made by Ezequiel Ordóñez (who has microscopically examined and classified the rocks mentioned in our study), is composed of sericite with fragments of feldspar crystals and grains of quartz.

Diabasic Rocks

The schists that we have described are in several places intruded and even covered by igneous rocks which have been designated as greenstone and *vacia* in this article. The greenstone may be divided into two parts: one, intrusive, formed of gabbro, diabases of olivine, quartziferous diabases (also designated as syenite) and andesitic diabases of ophitic structure; the other class is effusive and formed of rocks of similar composition to the diabases, although presenting different types of structure, such as the andesitic porphyrites which, in the region in question, are accompanied by porphyritic tuffs, breccias and diabasic tuffs.

The diabases, partly quartziferous by segregation in the magma, and with variations of structure due to the different conditions of cooling, appear in the ravines of Esperanza, Calera and Concepcion, where they present banks of diverse colors, dark and clear, and often green or gray. The same diabases occur in the workings of the Victoria, as well as in the Protectora, Cata, Tepeyac and other mines. There one also sees injections of diabases in the schists, or sometimes they form intercalated benches, as is observed at the surface in many places. Erosion has uncovered the benches of diabase which appear at the bottom of several ravines, for example, those of Jolula and Rayas. This intercalation of diabase benches in the schists was remarked by Humboldt.

After the intense folding of the schists, the intrusion of diabases and a period of erosion, there appeared the porphyrites with their accompaniment of breccias and porphyritic and diabasic tuffs, covering a wide area. This flow covered the schists in many places, as may be seen in the vicinity of Santa Ana and Esperanza. It filled up certain depressions, since we find the diabasic breccias in the mines of San Amado, Santa Brígida, and Peregrina, in the north and east of the region, as well as in *el alto* of the Veta Madre in the Rayas mine. The porphyrite or *vacia* is the predominant rock in the vicinity of La Luz, where it also occurs intercalated in the schists, this being the case in the San Cayetano and other mines. Moreover, it is found at the surface in different places.

Rhyolites

After the formation of the greenstone, appeared the rhyolites, partly spherulitic by reason of their slow solidification, and varied in coloration but with red pre-

[1] "The Guanajuato Mining District," ENG. AND MIN. JOURN., Vol. 77, pp. 600-601; 1904.

dominating. The rhyolites are usually accompanied by breccias and rhyolitic tuffs, gray in color and containing fragments of diabase or of porphyritic tuffs. These breccias occupy a large area at the surface, but they are also found underground, for example, in the Peregrina mine, at 222 m. and at 180 m. in El Cedro.

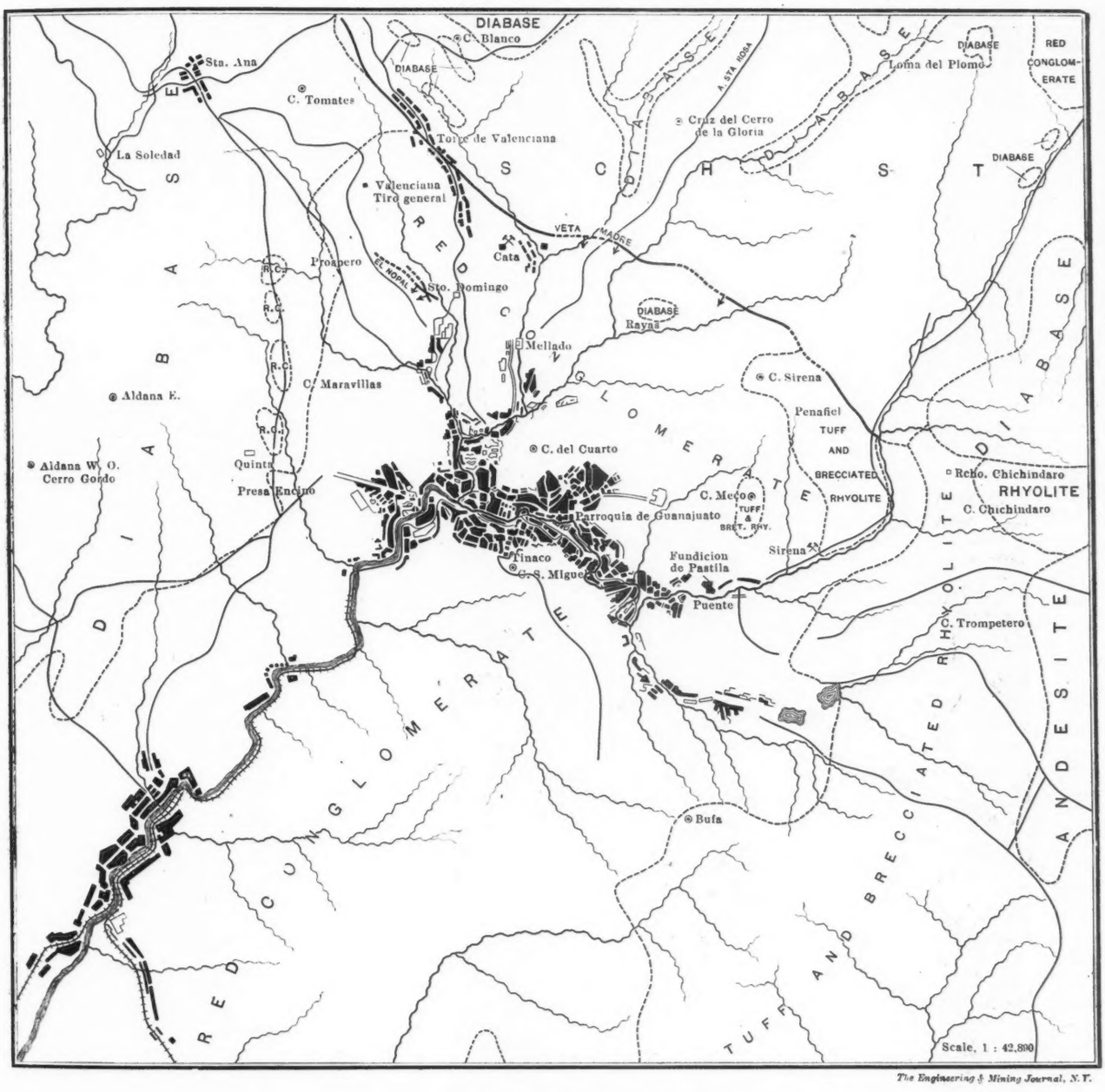
basaltites are found at the surface in numerous localities where erosion has uncovered them.

Red Conglomerate and Losero.

After the formation of the volcanic rocks that have been mentioned, there occurred in the depressions of the ground a formation of detritic rocks lo-

fragments are of variable size, sometimes large, but generally only a few cubic centimeters in size. Some of them are so small that they give to the detritic rock the appearance of sandstone.

No classification is followed in respect to the shape and density of the fragments, which, in general, are not rounded, but angular, with blunt edges. This in-



The Engineering & Mining Journal, N.Y.

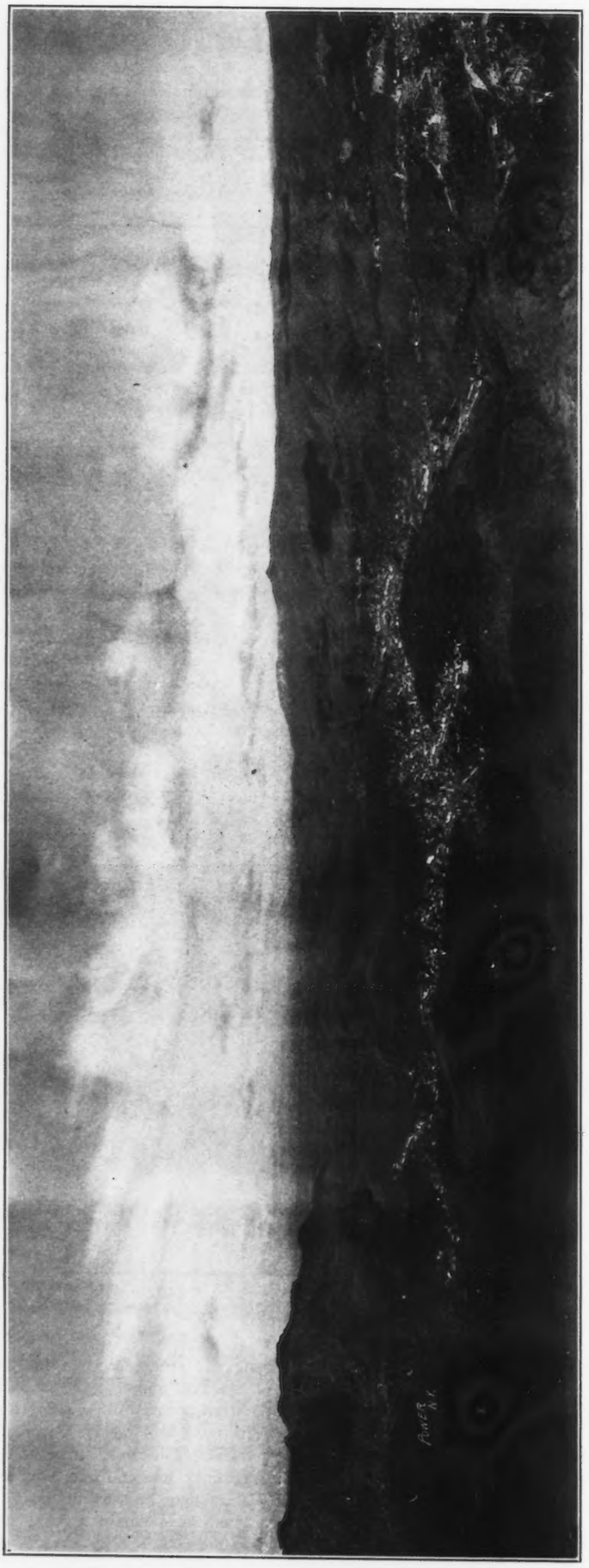
GEOLOGICAL MAP OF GUANAJUATO DISTRICT

Across the preceding rocks occur andesites of hypersthene and augite, sometimes so modified that they approach the basic types represented by labradorites and basaltites. These rocks are regarded as anterior to the red conglomerate because in the latter, fragments of old basaltite have been found in the Cerro de La Bolita. The foregoing andesites and

cally known as red conglomerate and *losero*. These depressions being surrounded principally by schists and diabasic rocks, the red conglomerate is largely formed of such materials. Thus we find fragments of argillaceous schists, diabase, porphyrite, blue stinkstone, felsitic rhyolite and, rarely, pieces of basaltite united by ferruginous clay. These

dicates that the breccia is due to torrential erosions, and that the materials have been transported only a short distance.

The red conglomerate occurs in strata of variable thickness, strike and dip, yet in certain places it forms very extensive folds, as may be seen in the vicinity of Pantéon de Guanajuato and the Mellado mine.



PANORAMIC VIEW OF COUNTY SURROUNDING GUANAJUATO

Conformably, and without abrupt transition, we find on the red conglomerate the *losero,* formed by thin layers of sandstone colored red at the bottom, with different tones of green above, and containing sometimes grains of quartz and fragments of feldspar.

These sedimentary rocks which, by reason of the elements composing them, are considered as forming part of the Neocene, occupy an extensive area to the north and south of Guanajuato.

As a last rhyolitic manifestation one may note an extensive flow, divided up by erosion, of rhyolitic tuffs covering much of the rocks already mentioned, even the red conglomerate and the *losero.* Across the conglomerates and the rhyolitic tuffs that cover them, there are thin, short dikes of pyroxenic andesite (camptonite) greenish in color and of ophitic texture. There may also be mentioned the basaltic emission of Cerro Cubilete, which is west of Marfil. The Pleistocene basalts extend for a considerable distance along the gorge of Aguas Buenas.

Historical Geology.

The geological facts already indicated may be summed up as follows: The marine strata composed of argillaceous and other schists, and calcareous conglomerates having once been formed, there commenced the continental period that reaches to our day. In fact, the only sediments later than the schists are the red conglomerate and the *losero,* the breccia and the sandstones which are the product of the destruction of pre-existing rock under action of torrential erosions, deposited in the depressions of the ground. After the intense folding of the schists and the intrusion of the diabases, which metamorphosed the former in irregular zones, came a period of erosion, after which appeared the Tertiary volcanic rocks, commencing with the porphyrites accompanied with breccias and with porphyritic and diabasic tuffs, which partly covered the schists and filled some depressions.

After the porphyrites appeared the rhyolites, accompanied by rhyolitic breccias, and then the andesites of hypersthene and augite which cut the rhyolitic breccias and covered then in different places. During a period calm from eruptions, were formed breccias and the Neocene sandstones composed of elements from the preceding rocks, which were transported a little distance and deposited in depressions of varying depth. Upon these last sedimentary rocks was spread a very extensive stream of rhyolitic tuffs which was divided up and furrowed, like the other rocks, by subsequent intense erosions. These erosions are in great part the cause of the numerous irregularities that are noticed in the present outline of the sierra of Guanajuato.

Subsequently to the formation of the red conglomerate, of the *losero* and of the superposed rhyolitic tuff, pressure has caused the inclination of the strata of red conglomerate and *losero* and has fractured the ground. Of these fractures which, perhaps, are contemporary with the basaltic emission of Cerro Cubilete, some have been filled by argentiferous minerals, thus forming the veins of the region. The basaltic eruption was followed by hydrothermal manifestations. Even in our day there exist at Aguas Buenas and in the hacienda of Chichimequillas, near Silao, springs of sulphurous water at temperatures from 35 to 96.6 deg. Centigrade.

The forces that fractured the ground were several times repeated, for there are fractures more or less narrow, some mineralized and others not filled, which cut the veins of the country. Finally, as very recent manifestations of these orogenic movements, we may cite the underground rumblings that were heard at Guanajuato at various times up to 1874.

Tectonics

Tectonic action combined with strong lateral pressure produced grouped fractures forming zones of diaclases, among which are distinguished four conjugate systems. The one most developed has a mean strike of 45 deg. northwest, this varying between 30 and 60 deg. northwest, with a dip of 45 to 75 deg. toward the southwest, and sometimes at the northeast there exists another system perpendicular to the former. There are two other systems of conjugate fractures, also at right angles.

The sliding of the walls of these fractures was relatively too small to merit the name of faults, and we therefore consider them as grouped diaclases, which fractured the ground in zones of regular width, slightly dislocated but much broken, and in which remained cavities with branches of irregular forms and sizes. These open spaces, of later date than the readjustment of the fragments of fractured rock, were filled with the minerals of which mention will be made later.

The zones of diaclases that were most extended in respect to their direction are those of the 45 deg. northwest system and a few of the north-south system. The latter have had a considerable influence on the distribution of the metalliferous wealth with which the former were filled.

Minerals

The most common primary minerals encountered in the veins of the sierra of Guanajuato are: polybasite, stephanite, argentite, and pyrite. There are also found, but more rarely: pyrargyrite, miargyrite, galena, blende, chalcopyrite and panabase. Among the very rare minerals are: freieslebenite, naumannite and proustite. The latter, however, abounds in the mines of La Luz.

The minerals of secondary origin that are most common are: iron oxides, argentite and native silver. Siderite, manganese oxides and native gold are less usual, though the latter is found in the mines of La Luz, El Carmen, El Cedro, El Nayal and others in greater quantity than in the mines of the Veta Madre. The rare secondary minerals are: Copper carbonates, cerargyrite, bromyrite, cerussite and chrysocolla.

The most common gangues are: quartz, compact or porous, amethyst, chalcedony and calcite; more rarely, ferriferous dolomite, valencianite and amianthus. The rarest gangue minerals are: Fluorite, gypsum, and barytine. In some mines of the district of La Luz, especially in El Refugio, apophyllite and stilbite are found in abundance.

Beside the valuable minerals mentioned there are occasionally encountered the following: Cinnabar, in the superficial zone of some argentiferous seams; guanajuatite, in the sierra of Santa Rosa; molybdenite, in El Nopal mine; alluvial tin, in the streams which descend from the foot hill north of the sierra of Guanajuato and in the vicinity of the hacienda La Sauceda.

Metalliferous Deposits

Some of the fractures of which we have already spoken are mineralized, especially those of the 45-deg. northwest system and a few of the north-south and east-west systems. These veins are so grouped as to form three zones: The first, which we shall call the central zone, is that where lies the Veta Madre; the second is to the north and east of the preceding and comprises the districts of Santa Rosa, San Nicolas Del Monte, Peregrina, Villalpando, Cubo and El Nayal; this is also referred to as the eastern. The third, or western zone, reaches from San Cayetano to the district of La Luz.

The central zone is the most interesting. It extends from northwest to southeast, from the *barranca* of Calera, near Santa Ana, to the plateau of Venadero, south of La Unión and La Torre mines, thus having an extent of 12½ km. in length and from 1 to 2½ km. in breadth. In this zone occur veins belonging to the 45 deg. northeast, the north-south and the east-west systems. These veins are inclosed in the sedimentary rocks and also in volcanic rocks.

Among the veins of the 45 deg. northwest system may be mentioned: The Veta Madre, which is the longest; those of Nopal, southwest of the Veta Madre; those of Avispero, La Juanita, El Caliche, northeast of the Veta Madre; the veins of Esperanza and Protectora in the northwestern part of the central zone; also, some small veins of the southeastern part of this zone, such as those of La Zorra, La Unión, Santa Isabel and El Refugio mines.

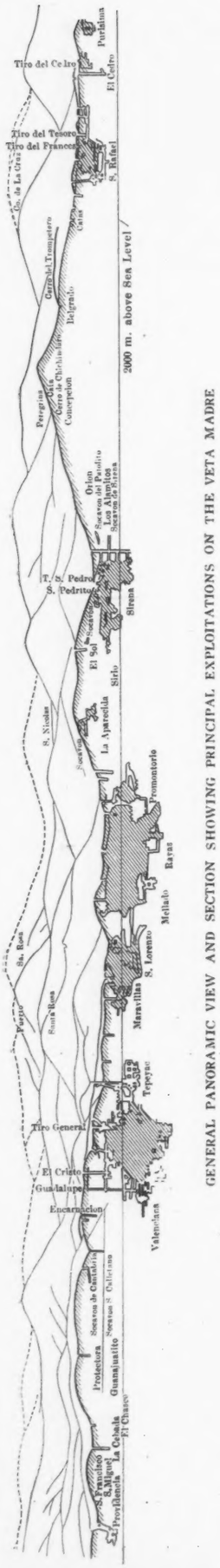
The Veta Madre

The Veta Madre extends from the *barranca* of the Presa de Esperanza to the northwest of the Valenciana, passing through the mine of the same name and those of Tepeyac, Maravillas, Cata, Mellado, Rayas, La Aparecida and Sirena, as far as the *barranca* of Peñafiel or Mata to the west of Cerro Chichíndaro, a length of almost 5 km. The mean strike of this vein is 50 deg. northwest, with dip to the southwest varying between 45 and 60 deg. The vein shows two considerable enlargements at the surface; one between the mines of Valenciana and Tepeyac, where the breadth of the outcrop is 25 m., the other being found in the vicinity of the Fraustos shaft, where it reaches a breadth of 45 meters.

The Veta Madre is situated in a zone of diaclases, fractures of unequal length and breadth, and grouped in diverse ways. They may be very near together, and in this case the vein forms only a single body, or they may be separated one from another, and the vein is then formed of different bodies divided by the mass of rock that constitutes the walls. In consequence, the sizes of the veins are decidedly variable, and there is a marked tendency for them to subdivide into different branches. The miners of Guanajuato class these bodies in three principal groups to which, according to their position, they give the names: *el alto, en medio* and *el bajo*.

These orebodies are not found all along the Veta Madre, nor at all depths, for sometimes there is only one of them, and that is often quite narrow. On the other hand, since the Veta Madre does not fill a free fracture with well determined walls and with considerable dislocation of the ground, that is to say, a paraclase, but on the contrary fills the empty and irregular spaces which remain after re-establishment of the rock fractured by numerous diaclases, it results that the available size of the metalliferous filling is exceedingly variable, both in respect to length and depth. In fact, in certain parts of the fractured zone, the wall rock dominates; in other parts there is an abundance of metalliferous filling, because in these latter places there are large open spaces.

The Veta Madre, at the surface and along a great part of its course, is found between the red conglomerate and the schist. At the bottom it cuts the schists and the diabasic rocks which are there intercalated. At some points it follows in contact with these rocks, while at others it is incased only in the diabasic rocks or in the schists. The presence of



GENERAL PANORAMIC VIEW AND SECTION SHOWING PRINCIPAL EXPLOITATIONS ON THE VETA MADRE

these two rocks, so different in hardness, and the presence of the igneous rock injected into the sedimentary rock, cause frequent changes in strike, dip and size of the diaclases when they pass from one rock to another. In consequence, the various orebodies and mineralized branches comprised in the fractured zone exhibit similar changes.

Distribution of the Ores

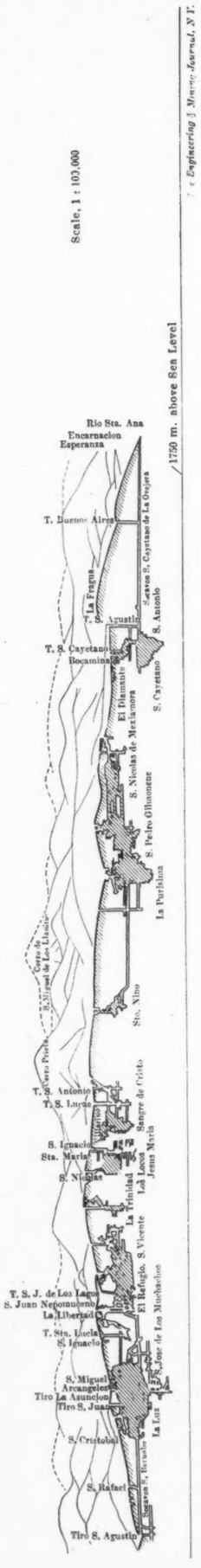
The empty irregular spaces, which remain between the fragments of wall rock broken by the diaclases, are later filled with the ores already indicated and these cementing the fragments give to the veins a brecciated structure. In many parts of these veins, the mineral cement does not assume the form of crusts, and this is why generally the structure of the veins is simply brecciated. However, in other places, as in the mine of Peñafiel and especially in that of Cata, the mineral cement occurs in the form of concentric crusts, forming what are called at Guanajuato *cintas de reata,* and among which may be mentioned, as an excellent example, those found in the Chiripa workings of the Cata mine.

The chemical history of the deposits in these open spaces is obscure. The chemical composition of the rock forming the walls appears to have had an influence on the nature of metalliferous fillings, but not upon the concentration of this filling in the zones of enrichment. The concentration seems to be due principally to the physical character of the wall rock, its hardness, and permeability. The first influenced the size of the cavity which later became filled with metalliferous deposits. The second, due principally to the crevassing of the rocks, played its part in the differentiation and concentration of the minerals in zones of enrichment. Thus, in almost all the mines of Guanajuato, it is observed that the richest parts are situated near the crossing of the veins with transverse diaclases of the north-south system; on the other hand, in the parts where these diaclases do not exist, the filling of the veins is poor in precious metals, or destitute thereof.

Age of the Veins

The veins of the Sierra de Guanajuato cut the red conglomerate and also the *losero;* consequently, they are later than the Neocene sedimentary rocks, and we shall consider them as belonging to the Upper Neocene, and to the same period perhaps as the basaltic emission of Cerro Cubilete.

The ascending thermo-mineral waters, by metasomatic substitution with the surrounding rock, and especially by mixing with solutions of different chemical composition, and under lowered temperature and pressure, deposited minerals in the empty spaces through which they passed, concentrating the useful metals in the zones



PANORAMIC VIEW OF REGION AND SECTION SHOWING EXPLOITATIONS ON LA LUZ VEIN

of enrichment, particularly, near the crossings of the principal fractures with the transverse diaclases of the north-south system. This mineral deposit cemented the fragments of rock and limited the circulation of water. The cementing material formed concentric crusts in various places where perhaps the circulation of water was more active.

In regard to the classification of the deposits, it may be said that they are epigenetic primaries filling preëxisting cavities in fractured zones; they have the form of brecciated veins and are due to the circulation of ascending thermo-mineral waters; the deposits are argentiferous, with an alloy of gold, and they are incased in argillaceous schists and in diabasic and rhyolitic rocks.

Exploitation of the Deposits

It is only in our day that improvements have begun in the mining methods of Guanajuato, which were previously exceedingly imperfect and uneconomical. The zones of enrichment called *clavos* have been mined in great part by opening for each of them a vertical shaft, sometimes very deep, such as those of El Cristo, San Antonio and Guadalupe in the concessions of Valenciana. These were costly workings that might have been avoided by economic and improved underground haulage, which would have allowed a great reduction in the number of vertical shafts. Underground haulage was done on the backs of men from the workings to the shaft, and sometimes to the entrance of the mines; but at present this service is by underground railway. The hoisting of ore and removal of water were formerly done by means of the old winding machines which have been replaced to a considerable extent by modern hoisting engines and electric pumps.

The quantity of water in the mines at Guanajuato is inconsiderable, and it may be said that the average flow is 7 liters per second in the deepest mines of the Veta Madre. The rock forming the walls of the veins offers no great resistance to drilling, while it is sufficiently firm to obviate timbering in many places. The ventilation of the mine is in the main effected by natural means.

The rich ores extracted from the mines are sent to the smelteries of the country; the poor ores or "azogues" which were formerly treated by the patio process or by pan amalgamation are today handled by cyanidation, this system of reduction being employed particularly for the ore contained in the old dumps.

Mine taxes in Mexico are levied by the Federal and State governments. They are practically a percentage tax on gross output.

Analysis of Babbitt Metal*

P. H. Walker and H. A. Whitman have made a careful study of the various rapid methods for the analysis of babbitt metal. Their investigations were carried on at the Contracts Laboratory, U. S. Bureau of Chemistry, and the method adopted if followed out and the proper corrections applied will yield as accurate results as those obtained by the tedious alkaline sulphide process, in a far shorter time and with much less labor.

Copper

One gram of the alloy is dissolved in a 250-c.c. beaker with 20 c.c. hydrochloric acid and 5 c.c. water, with the aid of heat and small amounts of nitric acid. Solution can usually be attained in a few minutes and without using more than 1 or 2 c.c. of nitric acid.

The solution is evaporated nearly to dryness, all of the acid practically driven off and the residue left in a pasty condition. To the residue is added 25 c.c. of a solution containing 200 grams tartaric acid and 260 grams potassium hydroxide in 500 c.c. of water. The whole is then heated on a steam bath until solution is complete, 25 c.c. of water added, boiled, 25 c.c. of a 0.2 per cent. invert sugar solution added, boiled two minutes and filtered through asbestos.

The precipitate of Cu_2O is washed with water, dissolved with nitric acid into a 200-c.c. flask and the copper determined volumetrically. Any of the good volumetric methods may be used. A plus correction of 6 per cent. should be added to the results due to the incomplete precipitation of the Cu_2O.

Lead

From 0.5 to 1 gram of the alloy is dissolved in a 250-c.c. beaker as in the copper determination and when solution is complete, evaporated to dryness on the steam bath. The residue is treated with 5 c.c. strong hydrochloric acid, warmed for a few minutes, then removed from the steam plate and 150 c.c. 95 per cent. alcohol added with stirring. The precipitate is filtered on a Gooch crucible after two hours' standing at room temperature, washed with about 100 c.c. of 95 per cent. alcohol, sucked dry and the crucible dried in an air bath for one hour at 105 deg. C. The lead chloride is then weighed and a correction of 0.0085 gram added to the weight obtained; the factor 0.74473 is used. The conditions should be strictly adhered to and with the exception that if as much as 10 per cent. of antimony is present, 10 c.c. hydrochloric acid is used.

Antimony

A slight modification of W. H. Low's method is followed. One gram of the alloy is heated in a 450-c.c. Erlenmeyer flask with 10 to 15 c.c. of strong sulphuric acid until it is thoroughly decomposed, which takes about 30 min.; when cool, 200 c.c. water and 20 c.c. strong hydrochloric acid are added, any sulphur dioxide expelled by boiling, and the solution rapidly cooled and titrated with potassium permanganate which has been standardized against metallic antimony. The first pink color that shows after agitation is the true end point. The results are from 0.3 to 0.4 per cent. high.

Tin

W. H. Low's method is also followed in the determination of tin. An amount of the alloy is taken that contains not more than 0.2 gram tin. The alloy (0.2 to 1 gram) is dissolved in a 450-c.c. Erlenmeyer flask with 10 to 15 c.c. strong sulphuric acid and when completely decomposed and cooled 200 c.c. water, 30 c.c. strong hydrochloric acid and 1 gram of steel turnings are added. The solution is again heated and when the reduction appears to be complete, but before all of the steel is dissolved, the flask is stoppered with a two-holed rubber stopper. One hole of the stopper should carry a tube which reaches below the surface of the liquid and the other hole should carry the short arm of a tube; the long arm reaches nearly to the bottom of a 100-c.c. Erlenmeyer flask containing a solution of sodium bicarbonate.

The small Erlenmeyer is held on the long arm by a cork having a notch in it to act as a vent. A stream of carbon dioxide is passed through the straight tube and the boiling continued until all of the steel is dissolved.

The flask is cooled as rapidly as possible, still continuing the flow of carbon dioxide. The stopper is loosened without interrupting the flow of gas, some starch solution added cautiously and the solution titrated with N/10 iodine. Air should absolutely be excluded and the iodine standardized against pure tin. The results are accurate.

The method has been carefully tested both against pure metals and against alloys which have been analyzed by the alkaline sulphide method, and been found to yield satisfactory results.

*Abstract of an article from *Journ.* Ind. and Eng. Chem., Vol. 1, pp. 519-522.

The copper deposits at Jiminez in the state of Chihuahua, Mexico, occur in a contact between overlying Cretaceous limestones and a granite mass, presumably intrusive. It is estimated that the overlying strata before erosion did not exceed 2000 ft. in thickness.

The Mexican department of Fomento (interior department), Mexico City, is now preparing good maps of several of the states. These maps are for sale at moderate prices.

The Mineral Wealth of the Cordilleras

Prospecting Is Inspired by the Desire to Obtain Gold and Silver. Base Metals Mining Is the Foundation of Permanent Industry

BY R. W. RAYMOND AND W. R. INGALLS

All history testifies that the mineral resources of a region have furnished both the impulse for its first development by man, and the foundation for its subsequent occupation by civilized and prosperous communities. In the pre-historic ages, the hunters, fishers, shepherds and gardeners of the world may have wandered or tarried without regard to the attractions of the mineral deposits which they could not utilize, and therefore did not value. But with the rise of civilization, as expressed in manufactures and commerce, the national value of such deposits began to be realized. Barbarous and remote tribes, possessing the sources of such supplies, won recognition in trade, long before they could attain it through any other means. Thus the North American Indians of Lake Superior exchanged their native copper for the mica of North Carolina, the ships of Tyre sailed all the way to Spain for lead and to Britain for tin, and the fleets of Solomon brought gold from Tarshish.

In modern times, it has been chiefly the precious metals that have stimulated exploration and conquest. The inherent qualities and the traditional value of gold and silver sufficiently explain this historic fact, the continued existence and potency of which is evidenced, even in our own times, by the occasional rush of eager adventurers to new districts where gold and silver have been discovered. The history of North and South America has been peculiarly influenced by this factor.

It was the prospect of obtaining gold and silver that led the Spanish adventurers to the shores of America, and the conquests of Mexico by Cortez and of Peru by Pizarro were inspired by the stories of the wealth of the Aztecs and the Incas. The explorations of the successors of these *conquistadores* discovered many famous bonanzas of the precious metals. The first silver sent to Europe from the mines of Mexico was obtained from Taxco, discovered by the Spaniards in 1522, only a year after the conquest. These mines, together with those of Pachuca, are considered the oldest in Mexico, some of them having been long worked by the Aztecs at the time of the arrival of the Spaniards. In 1540 work was begun by the Spaniards in the silver mines of Zacatecas, Mexico. In 1548 the first discovery was made at Guanajuato, Mexico. An event of great importance occurred in 1557, when Bartolome de Medina, of Pachuca, Mexico, invented the patio process of silver amalgamation. In 1793, mules and horses were used in Mexico, for the first time, for mixing the pulp, mercury and chemicals in the patio process, saving 75 per cent. in the cost of this process; prior to this time the operation had been performed entirely by human labor.

NOTE—This article is composed of excerpts from a paper in the *Transactions* of the American Institute of Mining Engineers.

The Greatest Deposits of Precious Metals Found in the Cordilleras

All these great discoveries and developments were made in the mountain chain, or series of ranges, locally known as the Rocky mountains, the Sierra Madre, the Andes, etc., but generally as the American Cordilleras, which extends, almost without interruption, from Alaska to Patagonia. Without claiming geological accuracy, we may include as a part of this great and complex continental back-bone the Sierra Nevada of California. Whatever the Alps, the Urals, the Carpathians, or the Balkans may have shown of mineral wealth, and whatever may be hereafter revealed in the Himalayas, the Mountains of the Moon or other of the imperfectly charted ranges of Asia and Africa, it may be safely declared that the American Cordilleras have not been and are not likely to be paralleled in continuity, extent and variety of mineral wealth, including in all parts of their amazing geographical length deposits of gold and silver. These two metals are so closely associated in nature that neither is ever found without some alloy of the other. The great mineralogist, Breithaupt, classified them together as a single mineral species, ranging in composition from almost pure gold to almost pure silver. We may at least confess that, in their attraction upon mankind, they have acted as one.

The Spanish conquerors happened to attack the continent where this great metalliferous range was nearest to the sea. Hence the earlier exploitation of Mexico and parts of Central and South America. The English colony at Jamestown, Va., and the expeditions of Ponce de Leon and other explorers in the Appalachian region, though equally inspired with the hope of finding rich deposits of gold, achieved no success, because they were far from the Cordilleras. It was reserved for later centuries to reveal the riches of the Rocky Mountains and the Pacific States and Territories, British Columbia, the Yukon Territory, and Alaska, through which these mountains extend. Even yet, the American Cordilleras cannot be regarded as thoroughly explored. Especially in Central and South America, they will doubtless be found to contain mineral deposits equal to the famous bonanzas of the past.

The Base Metals are the Basis of a Permanent Mining Industry

But the history of four centuries emphasizes one principle which may well be seriously considered, namely: that while mining in every new region may be originally inspired by the wish to obtain the precious metals, no permanent mining industry is established, and no substantial commercial development is secured, until the mining of the base metals and of the bulky minerals, especially coal, is begun. Precious-metal mining is characterized by the ephemeral camp; base-metal mining is distinguished by the growth of permanent towns, often cities, and an enduring population. This has been the history of the United States; it is becoming the history of Mexico; it will be the history of the countries of South America. We do not have to seek far to find the reason.

The precious metals are capable of extraction by crude methods, as gold is washed from gravel in Alaska at the present time with the aid of nothing but the pan. For more than three centuries the gold and silver of Mexico and South America were extracted by the patio process, which required the labor of men and animals, but little or no machinery, and the bullion product could stand transportation for long distances over mountain trails passable only to a man or a mule. The next stage of mining development is that wherein crude machinery is laboriously carried to the mine to aid in the working of the ore, the product of the ore still being gold and silver bullion. This was the situation in the United States when the mines of the Comstock Lode were being worked previous to the advent of the Pacific railway. Prospectors had roamed over many parts of Colorado, Utah and Nevada, and found outcrops of veins of lead ore and copper ore, but without the means for cheap transportation these discoveries were useless. The construction of the Pacific railway was anticipated as the supreme event in mining in the country west of the Rock Mountains, and this view was clear and far-

seeing as the future showed. The railway enabled the base metals to be taken to the markets of the world, developed great smelting centers, a permanent mining industry, and finally the agriculture and the manufacturing industry required to support the miner. Virginia City, dependent alone upon the gold and silver mines of the Comstock, has waned to a sickly shadow of itself, but Denver, Salt Lake City, and Helena, each of them a great smelting center because of the mining of the ores of base metals which are brought to their furnaces, have become permanent centers of population.

The Rejuvenation of Mexico

The rejuvenation of Mexico as a mining country dates from 1886, when Mexican lead ore, especially from Sierra Mojada, began to be imported into the United States in important quantities. It was only three years later, in 1889, that the mining of this base ore led to the establishment of silver-lead smelting in Mexico. This stimulated, nay compelled, the construction of railways and promoted the mining of ores of the precious metals required by the smelters for fluxing purposes. For example, the mines of Parral produce highly silicious silver ore, that is amenable to treatment by the process of hyposulphite lixiviation. In that way, the ore of the district was formerly worked on a small scale, but now Parral is one of the greatest mining towns of Mexico in respect to tonnage, the ore being shipped in bulk to the smelters who need it for mixture with other ores and treat it more cheaply than can be done by the old process of lixiviation. Along with this economy it is obvious that the railways and many other branches of industry are being supported by the work offered them to do. Although in the case of some ores the smelters are now having to meet the competition of the process of cyanide lixiviation, nevertheless it cannot be gainsaid that Monterey, San Luis Potosi, Aguascalientes, Torreon, and Velardeña, the smelting centers, are the real nuclei of Mexican mining prosperity.

Our purpose in emphasizing the importance of base-metal mining has been to call attention to the intimacy of the relation between that kind of mining and the development of improved means of transportation and the corollary that the industrial interests of a country can obtain no real advancement until comparatively cheap transportation for commodities is available. In the absence of such cheap transportation, the mining of base metals and the bulky minerals is generally impossible, but the possession of resources in such metals and minerals inspires the building of railways, after which other developments follow in the natural order of events. In especially favored regions the mining of base metals has been possible from a very early time. Thus an important mining industry for lead, copper and iron was established in the interior of the United States at a comparatively early date and without the stimulating influence of deposits of the precious metals, because the waterways of that region enabled the products to be carried out to the markets of the world.

The natural sequence to the establishment of base-metal mining is the creation of a demand for a great variety of minerals. The production of the base metals develops manufacturing industry, which requires such minerals as asbestos, borax, graphite, mica and many others unnecessary to mention. Thus the importance of any country as a mining and manufacturing country is well indicated by the variety of commercial minerals that it produces.

What Discoveries Will Be Made In the Future

In an essay upon the mining industry, the question of paramount interest concerns the future, and not the past, or even the present. Yet, to a large extent, the future hangs upon the past and the present. It has been the experience of the world through many centuries that deposits of valuable minerals in certain districts have been workable for long periods of time, although at any given time the remaining resources could not be estimated for more than a few years ahead. We are able to form a good idea of the unworked iron resources of Michigan, Wisconsin and Minnesota, which lie near the surface and are superficially extensive, so that this extent may be determined with comparative cheapness by surface pits and by drilling; also we are able to measure approximately the remaining resources of coal, a mineral which appears in seams of extraordinary extent and regularity, marked by well known geological phenomena. On the other hand, even in a country where mining is so well developed as in Mexico or the United States, no one would venture to indicate quantitatively the country's resources of copper, lead and zinc ores. Yet, although we cannot foretell the life of the copper mines of Lake Superior, or the lead mines of Bonne Terre-Flat River and the Cœur d'Alene, or the zinc mines of Joplin, experience has shown during the history of many years that they have been able to increase their outputs and we have no doubt that this ability will continue for a long time to come. Individual mines play out, but new ones take their place and thus the extent and productive capacity of the districts is increased, as in reflected by the statistics.

But as to new districts. From one point of view the chances for the discovery of new deposits of ore diminish constantly as explorations become more minute. From 1849 to 1879 new discoveries in the United States were common. Since 1879 they have been less and less frequent. Obviously, this is because the surface has been so carefully scanned that few of the prominent outcrops remain overlooked. However, this must by no means be accepted as a sweeping generalization. The pioneers who went to Colorado in 1859 inscribed on their wagons the legend, "Pike's Peak or Bust." Pike's Peak, one of the giants of the Front range, was the beacon whither they headed. Nevertheless, after more than 40 years, Cripple Creek, at present the greatest gold-mining district of the United States, was discovered in the very shadow of Pike's Peak, in a country which must have been trod repeatedly by the feet of the early pioneers. Prospectors overlooked the veins of gold ore occurring there because those veins were not of a character that they had learned to know as valuable. There are other districts where surface prospecting is extremely difficult. For example, in the Cœur d'Alene the mountain-sides are steep and densely wooded. Beyond doubt there are many hidden veins of silver-lead ore remaining to be found in that region. In these respects, or in analogous ways, we conceive that conditions are somewhat similar in Mexico and South America.

Advances In Geological Knowledge

But in spite of the keenness with which the surface of many parts of North and South America has been prospected, it is probable that only a small part of the mineral wealth of these lands has yet been disclosed. The many deposits of valuable ore occurring in the form of what may be typified as "blind lodes," i. e., veins that do not come to the surface, are not discoverable by superficial examination. Furthermore, there are cases of deposits appearing at the surface as ore of no value, which with depth change in character and become valuable. In the interpretation of these mysteries of Nature, the art and science of mining geology is contributing assistance of a character that our predecessors of a single generation ago could not even dream.

The discovery of ore is largely fortuitous. The ore exists where Nature has placed it. It remains for man to find it. When and how he may find it is more a matter of chance than anything else. But, although the discovery of ore deposits is chiefly fortuitous, the practice in the science of economic geology has greatly improved the ability of the prospector to prosecute successfully his search for ore and of the miner to estimate the value of his discovery. A few examples of how the advance in geological knowledge has been a factor in the development of our mineral resources may be usefully mentioned.

Only five years ago Ely, Nevada, which had been known since the '60s, was still regarded as a low-grade gold-mining dis-

trict, and efforts were being made to operate by improved methods the mines, which as gold mines had been failures for more than 30 years. The original exploitation for gold of districts which subsequently became famous for great deposits of base metals is no new thing. Mining began in that way at Leadville, Colo., at Bingham, Utah, and elsewhere. However, no one dreamed five years ago of the immense deposits of copper ore which underlaid the lean, copper-free gold ore of Ely. That discovery was analogous to the nearly contemporaneous discovery that the great bodies of gold ore at the Mount Morgan mine, in Queensland, Australia, were also underlaid by immense deposits of copper ore. These discoveries, to our mind, are of more importance than the development of the particular supplies of copper, inasmuch as they lead to a knowledge of new facts in the science of ore deposits which perhaps will be of immense value. History presents numerous precedents.

THE FUNCTION OF THE MINING GEOLOGIST

For example, the discovery of rich silver ore at White Pine, Nev., in a limestone formation was the prime cause of redirecting attention to the mineralization of the same kind of rock at Eureka, Nev., and ever afterward prospectors looked especially for great deposits of lead ore in limestone formations; not that limestone had not previously been known as a kindly rock for the deposition of lead, but that it remained for the discovery of the Eureka bonanzas to impress the fact on all minds. Similarly, the discovery of gold in the andesite and phonolite of Cripple Creek, Colo., in 1891, was followed by the rich discoveries at Tonopah, Goldfield, and Bullfrog, about 10 years later. Previous to 1891 American prospectors did not know that gold occurred in the andesite class of rocks, and were ignorant of the kind of ore indistinguishable by the eye from the mother rock, which could be determined as ore only by the pan or the crucible, but the prospectors of today have learned this lesson. The "heavy" rock that led A. B. Wood to the discovery of the carbonate deposits of Leadville troubled the placer miners of old Oro from the very beginning of their operations in 1860. Where was the prospector of 1880 who would not have identified it?

Now we conceive that the discoveries at Ely and Mount Morgan are likely to prove of a similar epochal character. Attention will be redirected to deposits of lean gold ore and drill holes will be put down through them to discover if they be underlaid by copper ore, while after the experience at Mount Morgan no manager of an old mine of similar occurrence will be safe until he has prospected the bottom of the deposit. In cases where the geological conditions are similar to those at Ely and Mount Morgan, prospecting of this character will be likely to develop the existence of similar deep deposits of copper ore. It is the function of the mining geologist, whose importance in the economics of mining is now well recognized, to study the conditions with a view toward such similar prospecting. It is immaterial as to whether this last discovery was first made at Ely or Mount Morgan. Its scientific importance is that in two cases great deposits of copper ore have been found under extensive bodies of gold ore, one of good grade, the other of low grade, neither of which at the surface or even at moderate depth, showed any indication of copper that would attract more than casual attention. It is in the deduction of generalizations from such new discoveries and their application to future prospecting that the mining geologist becomes the guide of the prospector and the mining engineer.

We anticipate that in coming years the triumphs of the mining geologist will become more and more frequent. Perhaps our successors of the next generation will be able to say that whereas the discovery of ore was once a matter of chance, or persistence in following venturesome speculation, it has become a problem of purely scientific deduction. But whatever may be the progress in this direction, we feel sure that the mineral wealth of North and South America, after four centuries of exploration, is still far from exposed, and that in the course of time the mines of South America will contribute to its countries a material development of the kind that Canada, Mexico and the United States have already experienced.

Transportation by Animals in Mexico

Anyone who studies a map of Mexico, with the routes of the different railroads marked thereon, now totaling about 25,000 km. (15,500 miles), says a correspondent of the *Iron Age*, will not fail to note that, with one or two important exceptions, they consist of lines running from north to south. Very large areas of the country, by no means unsettled or undeveloped, seeing that important mining enterprises are there carried on and large bodies of land are regularly cultivated, are still without modern transportation facilities. Between these settled districts and the railroads, be the distance far or short, the products, whether of mine or *hacienda*, have to be carried by either horse, mule or donkey. The same methods are employed in the transportation to the cities of the varied commodities brought in daily from the country, such as wood, charcoal, etc. Mules and donkeys also are employed in very large numbers at the mines and ranches at the regular daily work. It would be a mere guess to estimate the proportion of the actual carrying business of the entire country which is today performed by four-footed freighters, but it is undoubtedly large, notwithstanding the activity of the railroad companies in making new extensions yearly into virgin territory.

According to statistics of the Direccion General de Estadistica, the number of freight animals in Mexico in 1902 was as follows:

States.	Horses.	Mules.	Donkeys.
Aguascalientes	4,991	3,248	3,042
Baja California	8,655	3,429	2,179
Campeche	2,969	3,031	944
Coahuila	55,825	10,978	6,487
Colima	4,321	2,453	874
Chiapas	42,427	5,896	561
Chihuahua	59,667	9,401	25,544
Distrito Federal	834	1,435	466
Durango	104,674	32,931	28,109
Guanajuato	31,396	15,547	40,948
Guerrero	16,140	4,348	6,330
Hidalgo	8,636	8,382	4,553
Jalisco	70,877	27,497	16,990
Mexico	11,317	9,365	3,029
Michoacan	54,548	26,390	15,106
Morelos	9,255	7,830	4,210
Nuevo Leon	28,088	7,514	15,969
Oaxaca	12,854	3,214	2,515
Puebla	9,526	25,602	6,661
Quer taro	8,333	5,378	5,778
San Luis Potosi	36,340	12,219	21,905
Sinaloa	6,594	5,618	6,989
Sonora	52,033	11,354	13,338
Tabasco	20,160	3,276	259
Tamaulipas	69,611	14,447	10,291
Tepic	13,086	8,968	5,399
Tlaxcala	2,682	14,877	2,146
Vera Cruz	40,914	10,574	5,988
Yucatan	15,700	13,318	537
Zacatecas	56,764	25,735	29,844
Total	859,217	334,435	287,991

The above total is undoubtedly an under estimate, as any one at all familiar with the habits and manner of thought of the Mexican small proprietor, who has ever before him the fear of more taxation, will at once understand. The total could be increased one-third, probably, without exaggerating.

Chrome ore is now being imported into the United States from Portuguese East Africa; 294 tons in 1907 and 2200 tons in 1908. According to U. S. Consul W. Stanley Hollis, Lourenco, Marquez, the ore is mined in Rhodesia and sent by rail from Selukwe to Beira for shipment. During 1907 chrome ore valued at $22,694 was declared at the Beira agency for New York and Baltimore which, however, went to England for transshipment.

According to an official report the silver production of Missouri in 1908 was 25,000 oz. The production for previous years has been as follows: 1907, 25,300; 1906, 31,300; 1905, 12,900. Practically all of this is refined from the lead bullion produced by the lead mines of the southeastern part of the State.

At the San Rafael mill, Pachuca, Mexico, the consumption of chemicals per ton of silver-gold ore treated by cyanidation is reported to average 1 kg. sodium cyanide, 0.2 kg. acetate of lead and 12.2 kg. lime.

Recent Mining Developments in Chihuahua

Conditions Improving with Principal Mines Operating and Further Pearson Investments. Drought Broken but Zinc Ore Tariff a Serious Blow

BY A. P. ROGERS*

Chihuahua suffered from the effects of the financial depression most keenly, and is only now beginning to feel the general revival in business conditions. Added to the financial stress this State has had an exceptionally dry season this year, which has proved to be a very serious matter to many mines which depend upon water for power; and finally, the United States has imposed an almost prohibitive tariff upon zinc ores imported into that country. This zinc tariff has been a heavy blow to many mines which were formerly shipping a large tonnage to the zinc smelteries in the Middle West, and which are now obliged to find other markets for these ores as Mexico has no zinc-smelting plants. In spite of all these setbacks, however, work at the large going mines and numerous prospects has been quietly progressing with good results, and the present indications are that conditions will soon assume a normal aspect. Chihuahua is so rich in natural resources and has such varied mining, timber, ranching and railroad interests that a stimulus in one direction cannot help benefiting all the others in some degree. Such a stimulus is now being felt from the large investments of the Pearsons in the pine-timber tracts of western Chihuahua, and the consolidation by these same interests of the Chihuahua & Pacific Railroad with the Sierra Madre & Pacific Railroad under the name of the Mexico & Northwestern Railway. This company has an authorized capitalization of $40,000,000, of which $15,000,000 has been issued, and a bonded debt of £5,000,000, of which £3,000,000 is issued, bearing 5 per cent. interest. The Pearson syndicate also has engineers in the field surveying a route from Casas Grandes to Madera, which will connect up the two lines, giving a total of 612 miles, which will be in operation by Jan. 1, 1911. The same syndicate is putting the large sawmill at Madera in condition to work. This plant has a capacity of 250,000 ft. a day, and a larger one is planned to be built at El Paso, Texas. The timber lands acquired from the Greene Gold and Silver Company, and the Development Company of America, are of vast extent, covering over 2,700,000 acres, a great portion of which is timbered with heavy pine forests suitable for lumber of the highest grade. These forests are estimated to contain at least 8,000,000,000 ft. of lumber, valued at $20,000,000.

During the last year the Kansas City, Mexico & Orient Railroad has extended its line 14 kilometers west of Sanchez, the former terminus of the road, and is making one of the deepest cuts in the world through a hill at that place, 600 ft. long by 110 ft. deep at the deepest point. Once this road is through the mountains, direct railroad connection will be established between Chihuahua, Guaymas and the west coast. It will take some time, however, as the most difficult part of the road has yet to be built, and it has been so far a slow task to raise the large capital needed.

While a time of financial stress bears heavily upon many enterprises, it has some good effects also in eliminating a lot of doubtful undertakings, and bargains are offered to the stronger interests which might otherwise hesitate to invest their money. Now that business is picking up, these people can be relied upon to exert their energies toward developing the country, and the general indications for a prosperous future throughout the State are most encouraging.

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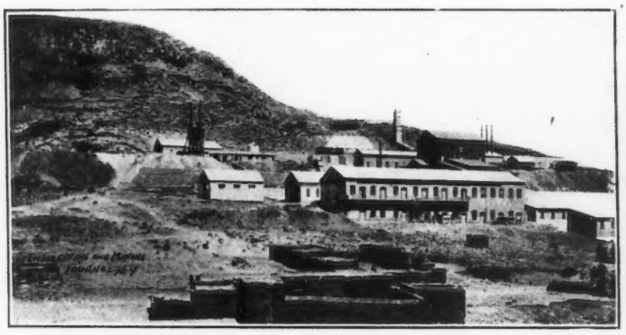
Santa Eulalia District

The Santa Eulalia camp has not seen many changes lately, although the San Toy mine, which was purchased for a large price by Charles M. Schwab, two years ago, has become an important producer under the management of Donald B. Gillies, and is shipping 100 tons a day of 90-oz. silver ore to the Torreon smeltery. The company had not much ore in sight when the mine was bought, but a campaign of vigorous prospecting has determined the original ore channel, and now the mine is turning out to be a very successful property. At the present time the workings are about 400 ft. deep. Another important producer in this camp is the Potosi mine of the Chihuahua Mining Company, which is shipping 600 tons daily, carrying 20 oz. silver and 15 per cent. lead to the El Paso smeltery. This company was also shipping a large amount of zinc ore, but the tariff has forced it to suspend these shipments. At Mina Vieja, in this camp, the Guggenheim Exploration Company is completing an aërial tram line from the mine down to the town.

The Chihuahua smeltery of the American Smelting and Refining Company formerly bought much of the custom ores at Santa Eulalia, but at present it is principally handling the lead ores from its own mines. The plant has been running for some time at its full capacity, however.

The Rio Tinto mine and smeltery at Terrazas has been purchased by Corrigan & McKinney, of Cleveland, Ohio, and the plant is now being successfully operated under the management of R. B. Hutchinson. The smeltery has a capacity of 200 tons of copper ore a day, practically all of which comes from the company's mines. A high-grade matte is made and shipped to Europe. The owners of this property



REFUGIO MILL, PARRAL

PALMILLA MINE, PARRAL

formerly sold the Concheño mine to the Greene Gold and Silver Company. After making the first payment upon the purchase price, the company defaulted and the property reverted to Corrigan & McKinney, and is now under contract to T. F. Cole and associates. The old Americana mine has again become prominent as a shipper in the hands of Dale & McDonald. It was thought that this property was worked out at one time and the lower workings were flooded, but the present owners have uncovered another shoot of good ore near the surface that is turning out well, and regular shipments to the smeltery are being made.

Naica Output Increasing

The Naica mine has been carrying on vigorous development during the past year with excellent results. A large amount of good ore has been opened up in the various levels and the directors report there is today 122,780 tons of first-class ore and 17,600 tons of second-class ore in the reserves. The estimates are made only down to the third level, 150 meters below the yards, but the entire floor of the ore chimneys is formed of ore. The quantity of ore shipped to the smelteries during the past six months amounted to 11,700 tons, containing 450 gm. silver, 3.5 gm. gold and 23 per cent. lead a ton. From the organization of the company to the present time, a total of 161,128 tons of ore has been sold to the smelteries, for which $5,499,568 has been received—an average of $33.82 a ton. Of this amount the stockholders have received $2,650,800 in 207 dividends. The company no longer ships its ores to the Torreon smeltery—that contract having terminated—but has made more favorable arrangements with the Encinillas smeltery at Santa Rosalia, Chihuahua, where most of the output is treated, the balance going to the Compañia Metalurgica Mexicana at San Luis Potosi. It is probable that the Naica company will soon build its own smeltery on the property. The mines are connected with the main line of the Mexican Central by a branch 30 km. long, owned by the company. The power plant which supplies the mine with compressed air for the drills and hoists is taxed to supply enough power for the drills in use.

A French company has recently acquired 120 pertenencias at Naica and intends to carry on prospecting on a large scale, under the direction of H. G. C. Thofehrn, the manager. At the San Francisco property, adjacent to the Naica Consolidated, J. R. Roslyn expects soon to commence work upon a long tunnel. It is also reported that the Encinillas company, at Santa Rosalia, is planning to increase the capacity of its smeltery soon by adding another 250-ton lead furnace. This company has been doing a very good business the past year, under the management of T. S. St. Dezier, treating the ores from Santa Eulalia, Naica and Parral.

Parral District

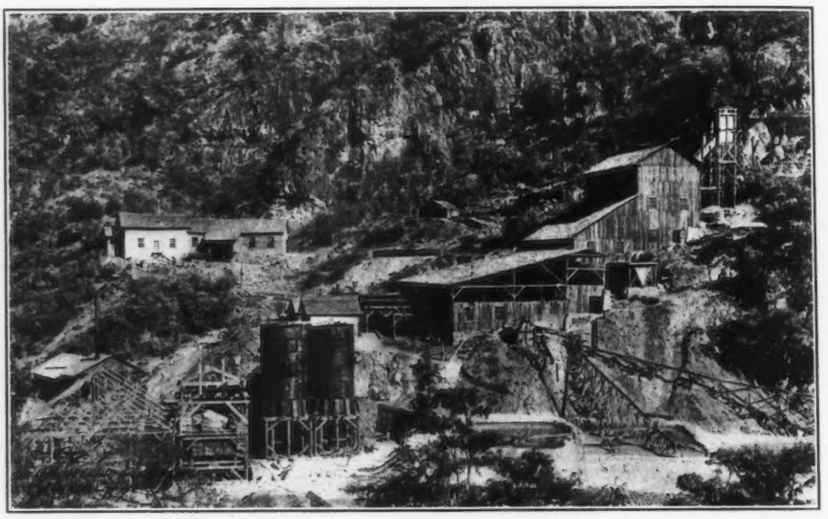
At Parral the heavy flow of water from the lower levels in the mines and the low grade of ore, together with a low price for silver, have curtailed operations. Messrs. McQuatters and Long have been actively engaged in organizing the Alvarado Mining Company to work the Palmilla mine of Pedro Alvarado, and a custom mill is planned to handle a large tonnage.

The Hines Consolidated Company is to be reorganized and operations started. This mine has a large amount of low-grade ore. One of the important properties in the Parral district today is the El Rayo mine, which is making a good showing under the direction of George A. Schroter, consulting engineer. The production in July was over $47,000—from a mill-run of 27 days, treating 3612 tons, from which a net profit of $25,000 was made. The ore averaged over $16 a ton, and an extraction of 90 per cent. was obtained. The mine has, according to reports, ore positively developed to continue this rate of production for several years to come.

Other Properties

The Calera mine, controlled by Grant B. Schley, and the other zinc properties about Miñaco have all had to shut down owing to the American tariff on zinc ore. The owners have to figure on shipping to Europe, but it will take some time to arrange for such a move, and in the meantime the properties are likely to be idle unless the price of zinc in the United States advances materially. One of the best properties working near this district today is the Promontorio mine at the old Cusiriachic camp, owned by the Cusiriachic Mining Company. This is a large gold-silver property, which was bought last year by Potter Palmer, Jr., and associates, of Chicago. The management has entirely retimbered the mine and completed the installation of the new plant, and is now producing on a much larger scale than heretofore.

The large mines of the western part of the State are widely separated, and many of them are run by water power. Water has been very scarce this season, but in spite of that a good showing has been made. The Batopilas mine is in bonanza again, and is now installing a cyanide plant to replace the lixiviation process. The mine is under the management of Alexander Sheppard, and Walter M. Brodie, of Chihuahua, is the consulting engineer. The Republica mine, in the Jesus Maria district, has had some trouble lately from the heavy flow of water, and is now partially flooded. The company was paying $20,000 a month in dividends from 100-oz. silver ore until this happened. It is hoped that larger pumps will handle the water and the production can be resumed.



RIO PLATA MILL, WESTERN CHIHUAHUA

On the Septentrion river the Rio Plata mine was very short of water last spring, but the rainy season has now begun and the mill is running well. This has been a large producer so far under the direction of D. W. Shanks, and all the levels are reported to be in good ore today. The mine paid for itself during 2 years prior to last May. It is a tunnel proposition from which the ore is trammed to the new 25-stamp mill and cyanide plant. This cyanide plant has just been installed, and for the first month's run treated 80 tons a day, giving an extraction of 82 per cent. Two water wheels, recently installed, have shown defects and are now being replaced so that there should be no further trouble, and a steady production can be maintained in future. During July they treated 1464 tons of 60-oz. silver ore, recovering 88,000 oz. The recent developments in the mine have proved the continuity of the ore-shoot, which averages from 3½ to 6 ft. wide, and shows assays up to 200 oz. in

silver in the working faces. The greatest trouble encountered was from a lack of water during the spring months, but that will be overcome in future by the auxiliary steam plant installed last year.

At the Dolores mine, the recent developments have opened up large additional reserves of high-grade gold ore, and the property was never in such good condition. This is the first season the water-power equipment has been in operation, but it has been so extremely dry the mine was able to run the mill by this power only part of the time, and it will take some time to determine exactly what will be accomplished. In the mine, the main Dolores shaft has been sunk an additional 100 ft., from the bottom of which a crosscut cuts the vein in 50 ft. Drifting toward the south upon this level has opened up a good body of ore from 5 to 8 ft. wide, assaying $35 to $40 per ton, with ore still in the present breast. To the north low-grade ore was found, but at 150 ft. the oreshoot, developed in the level above, is expected to be encountered. Besides this work in the main mine, considerable prospecting is being done on some of the other veins upon the property with good results.

The conditions are favorable for a resumption of activity in mining in the northern Mexico districts, and the improvement is already marked.

English Investments in Mexico

As early as 1824, English capital was attracted to the mines of Mexico. The firm of John Taylor & Sons, of London, about that time became heavily interested in Pachuca and other English and Scotch companies followed, taking properties in all parts of the country. One company, the United Mexican Mines Association, about the middle of last century, owned and worked mines at Minas Nuevas, Sonora, Jesus Maria, Chihuahua, in Durango, at El Oro, in Temescaltepec and Zacualpan in the State of Mexico, at Guanajuato and in Oaxaca. It took a visiting director two years to see all of the properties of the company. With the sale of the San Cayetano mine at Guanajuato a few years ago to an American company, the United Mines company passed out of Mexican mining. A Scotch company developed Guanacevi, Dgo. in the '40's and built a mint, with machinery so substantial that the authorities have recently been unable to move it away. An English company installed enormous Cornish pumps at Fresnillo, near Zacatecas, bringing them overland from Veracruz at a great cost. Other important English operations were at Zimapan, north of Pachuca. Most of the English companies abandoned their properties between 1850 and 1860, owing to the insecurity of government and the heavy costs of operation and transportation. When the Americans became interested in Mexico, in the '80's, the English had practically retired from the field.

In the past decade the English interest in Mexico has revived and there are now several important English companies in the field and English capital is largely interested in the El Oro mines and other American controlled mines. Recently many English engineers from South Africa and Australia have come to Mexico looking for mining properties. The indications are very strong for an increasing English investment in Mexico, independently, and in conjunction with the Americans.

Consolidated Goldfields of New Zealand

SPECIAL CORRESPONDENCE

The report for the year ending Dec. 31, 1908, states that the gross profit for the year from mining operations on the Wealth of Nations, Humphrey's and Golden Fleece mines, together with dividends on investments amounts to £17,654, out of which a dividend of 1s. per share (5 per cent.) was paid in October. The Wealth of Nations mine is, as regards development, considered as three years ahead of the mill. Additional power has been obtained by regrading the last mile and a quarter of the water race to the reduction works.

The Golden Fleece mine has been worked on tribute, the tributors paying 15 per cent. of the gross gold won up to a standard of 8 dwt. per ton and 20 per cent. over this amount. The Humphrey's Gully alluvial workings have been worked at a loss, but it is expected that the working would be payable if worked by tributors. The Consolidated company holds 160,000 shares out of a fotal of 275,000 shares in the Progress mines and 94,924 shares out of 250,000 shares in the Blackwater mines. During the year the Progress mines treated a tonnage of 48,500 tons for a profit of £15,824, which is a decrease of £21,665 over the results of 1907. The results of the development work carried out during the period under review were disappointing, the large bulk of the quartz exposed being below the payable limit in value.

The ore received is estimated to be equal to a year's supply for the mill. In order to work up a large accumulation of pyritic slimes, concentrates and chlorination residues, and also in order to treat the concentrates made monthly, it has been decided to erect a smelting plant consisting of a reverberatory furnace and arsenic-condensing chambers. An analysis of the working expenditures and revenue on 48,500 tons milled and 33,300 tons cyanided shows that the revenue per ton was 25s. 3d., and the costs (exclusive of capital and development expenditure) 22s. 10d. per ton. The Blackwater mines, which were formed as a company in December, 1906, commenced milling in August, 1908, and now has a battery of 30 stamps. For the four months ending Dec. 31, 1908, the revenue was £17,752, and the expenditure (exclusive of development), £9481. For the seven months ending July 31, 1909, the revenue was £33,457 from 14,440 tons milled, or at the rate of 46s. 4d. per ton. The costs, including development, were £14,453, or 20s. per ton.

During January, both mine and mill were shut down in consequence of labor troubles. At the end of 1908 the tonnage blocked out was estimated to be 2½ years ahead of the mill. The latest returns from the mine, those for August, are the best yet recorded. The 30-stamp mills produced gold to the value of £7283 from 3000 tons of ore, at a cost of £1995 for mining and milling and £420 for development making a total of £2415, or 16s. per ton.

Soldering Platinum

Soldering ordinary platinum vessels is commonly done with platinum itself as the soldering material, or with pure gold, using the oxyhydrogen blow-pipe or its equivalent melting flame. Gold has the disadvantage that it melts at a lower temperature than the platinum, and under temperatures to which crucibles or other vessels may be subjected, it melts and leaves the crack open.

In *Central-Zeitung für Optik und Mechanik* it is recommended to close the crack with a mixture of platinum powder and turpentine oil, then to heat the joint to a white glow, and in this condition to hammer the parts together. Another method, applicable where the crack is on the edge, consists in hanging a narrow strip of platinum sheet over the crack, then placing the article in the fire, heating it white hot, and hammering if necessary.

According to *Metall-Arbeiter* a small hole may be closed by a rivet made of platinum wire, welded after hammering both heads closely. For larger holes a patch is made of platinum sheet, riveted on, and then weldel.

Consolidated Mercur Gold Mines Company

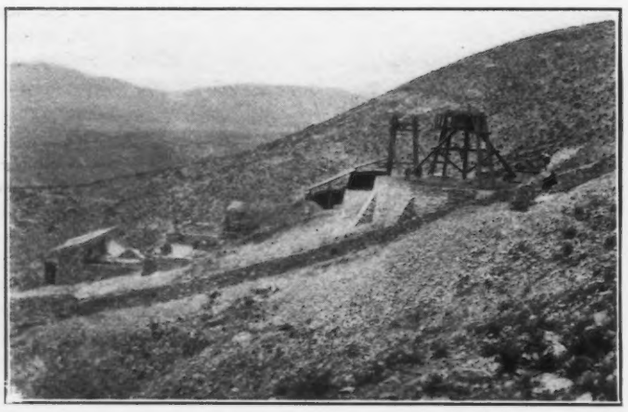
The president's report Aug. 23, 1909, for the year ended June 30, 1909, states that during the year 282,269 tons of ore were mined and milled. The gold produced was $761,236 or $2.70 per ton. Loss in tailings, per ton, $0.88, making the total value of the ore $3.58 per ton. Mining costs were $1.53 per ton, and milling $1.09. Assets, $75,039; liabilities $9.16. During the year $5606 was expended on account of slime plant construction.

Dulces Nombres Quicksilver Deposit, Mexico

Orebody Found in Limestone; Differs from Other Quicksilver Deposits in Origin and Occurrence; Production of Over 1,000,000 Pesos Since 1890

BY PERCY ANDRUS BABB*

A dozen or more states of Mexico record activities in the mining of quicksilver. Those best known, however, are Guerrero and San Luis Potosi, due partly to the magnitude of the production and, also, to the publicity of the interesting geological features of the deposits of Huitzuco in Guerrero and of Guadalcazar in San Luis Potosi. Generalizing relative to the quicksilver deposits of the country, Sr. Juan D. Villarello, president of the Sociedad Geologica Mexicana, in a monograph published in 1903 under the title "Genesis de los Yacimientos Mercuriates de Palomas y Huitzuco," remarks upon the general association of cinnabar with pyrites, stibnite, realgar, silica, bitumen, and often tetrahedrite, gold, sulphur and gypsum. He says it is almost always true that in deposits of mercury, bitumen and silica are found in the gangue accompanied by pyrites; in some, as at Huitzuco, the sulphantimonide of mercury with sulphur and gypsum occurs; and in many others, as at Huitzuco and Guadalcazar, in Peru, and at Sulphur Banks, Cal., gases and water issue from the workings charged with carbonic acid and hydrogen sulphide. He might have noted, also, that the quicksilver deposits occur oftener than otherwise in Cretaceous formations, intimately connected with igneous eruptions, although there are exceptions in which deposits are formed altogether in eruptive rock. J. F. Kemp calls attention to the fact that quicksilver ores are quite invariably associated with igneous rock, although the walls are often sedimentary. G. F. Becker has tabulated the minerals accompanying cinnabar from 28 world-wide localities, showing that silica, either as quartz or in the opaline state, and calcite are the common gangue minerals. Pyrite or marcasite is invariably present and bitumen is very widespread. Various other antimony, arsenic, silver, lead, copper, and zinc minerals, as well as gold, are of somewhat irregular occurrence. He holds that the cinnabar has come up in solution as a double sulphide with the alkaline sulphides, but places emphasis upon the precipitating properties of bitumen. He considers the likely source of the ore to be in deep-seated and widely distributed granitic rocks, and especially in such portions as overlie the foci of volcanic activity.



DULCES NOMBRES QUICKSILVER MINE, SAN LUIS POTOSI, MEXICO

Dulces Nombres Deposit Unique

The Dulces Nombres deposit of quicksilver lacks almost all of these general characteristics set forth in the preceding paragraph, and is certainly unique as to the genesis of the ore and its mode of occurrence. The district is practically unknown, the only mention I find in the press is a brief reference in THE MINERAL INDUSTRY of 1907 to the Guadalupana mine, immediately south of Dulces Nombres. The deposit is not only of geologic interest, but has been a successful commercial undertaking. It is now operating on a profit basis, and during the year of 1908 marketed 700 flasks of quicksilver, the recovery from 785 tons of ore averaging 3.98 per cent. Hg. During the last two decades something in excess of 10,000 metric tons has been extracted, from which have been won in excess of 14,000 flasks liquidating over a million pesos.

The property is approximately 15 km. west of the railroad at Enramada, a station in the state of San Luis Potosi on the Mexico-Laredo line of the National Railways. The Dulces Nombres mountain reaches an altitude of 2300 m. above sea level, and the floor of the valleys is 300 m. lower. No water has yet been encountered in any of the workings—the greatest depth of the workings is 100 m. —nor is it likely that any will enter for another 150 to 200 m. The rock is self-sustaining, requiring no timbering—even the shafts are untimbered with the exception of the collar-set. Competent miners are paid one peso per 8-hour shift; mechanics, carpenters, masons, blacksmiths, etc., one peso per 10-hour shift; and general labor half a peso—8-hour shifts if in the mine, otherwise 10-hour shifts. Simple and light equipment meets all demands, and operating costs are exceedingly low in terms of rock excavated.

The history of the camp is comparatively recent, dating back to 1890, when Dulces Nombres proper was denounced by a Mexican ranchman who discovered rich specimens of cinnabar strewn along either side of the *arroyo* which dissects the property. Until very recently the property lacked intelligent mining; the extraction was always carried right up to the exploration faces, and ore encountered wherever it might be and pursued wherever it led. The experience of the operators has been a series of ups and downs—*bonanzas* productive of big returns alternating with workings barren of ore. The present company has undertaken much needed exploration work, operating the property with more regard to approved mining practices.

Interesting Geology of the Deposit

The Dulces Nombres formation belongs

*Mining engineer, Mexico City, Mex.

to the Central Plateau region, an immense table land mostly of Cretaceous sedimentaries, which have been extensively intruded and uplifted during the Tertiary era, forming numerous isolated ranges, termed rather aptly "lost ranges" by Robert Hill. The Dulces Nombres uplift extends 4 km. north and south and 3 wide—hardly a range, but rather one mountain mass eroded into several crests projecting somewhat above the body of the mass and dissected by two main *arroyos*.

The mass of the mountain is composed of stratified limestone of the Comanche series of the Lower Cretaceous formation; the strata varying from 10 cm. to a meter in thickness, and made up of numerous laminations which disclose themselves where weathered or altered by descending waters. Due to bitumen present in the limestone their color is black and dark gray. A general analysis of the limestone is as follows: CaO, 46.35 per cent.; SiO_2, 12.46; Al_2O_3, 1.93; CO_2, 36.42; C, 1.30; total, 98.46 per cent. plus a trace of iron.

The carbon is very combustible, therefore it cannot be graphite; but where there has been intense movement between beds, graphite does occur.

Resting on the Lower Cretaceous and conformable with it are the lower beds of the Middle Cretaceous, but the upper beds of this formation have been entirely eroded. The Middle Cretaceous is characterized by interbandings of chert, beds of approximately the same thickness as those of the Lower Cretaceous, lack of visible laminations, and a gray to light-gray color where weathered.

Several hundred meters to the southeast of the Dulces Nombres, there outcrop sandstones of the Upper Jurassic, calcareous in composition, but the conformability to the younger formation was not ascertained. It is not certain but that their presence here is explained by their having been faulted.

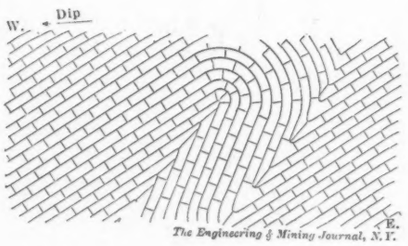
The strata have been tilted about 50 degrees, dipping west, with local variations ranging from vertical to horizontal in places. The mountain has a north-south trend corresponding with the direction of the limestone strata.

No Igneous Rock Associated

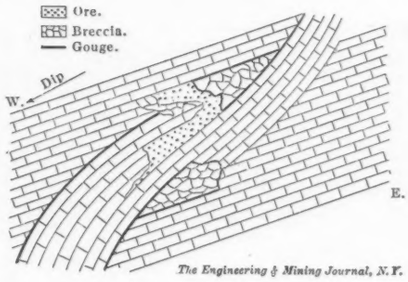
No igneous rocks outcrop on the Dulces Nombres mountain. To the north, east and south, however, on other ranges several kilometers away, igneous rocks outcrop and lava is found; moreover, a few kilometers to the east are several eruptive cones. To the north and the south fissure veins have been found carrying low silver and gold values at the surface. These have never been prospected. Surrounding valleys completely isolate the Dulces Nombres from these other uplifted areas; nevertheless, we are justified in assuming local activity of intrusive rock as the cause of the uplifting and tilting of the limestone now referred to as the Dulces Nombres mountain.

Incidental to the uplifting of the limestone a strong faulting occurred where the tilted strata were broken away and lifted up from the beds now extending to the east, the eastern slope of the Dulces Nombres mountain being the eroded fault plane. Since then there is no evidence of faulting, although there have been many slight local movements involving displacements of a centimeter to 15 cm., and resulting from the adjustment of the tension within the mass of disturbed rock.

The limestone has been subjected to thrusts at right angles to the direction of the strata, i.e., against the dip, bending and folding the beds into small, irregular and distorted areas. On the surface the strata may be seen in places folded into



FOLDING OF CRETACEOUS LIMESTONE



TRAP FORMED BY FOLD

Z's and pleats and the parallelism of the beds unbroken along the strike; but underground the folds are usually found ruptured, the sides coming together as acute angles, having formed gouge and slickensides. As the major part of the local movement occurring underground is in the vicinity of these highly distorted areas, it is not unlikely that they are the effect of the breaking down of the folds.

The ore occurs as widely scattered pockets and stringers of high-grade mineral within the downward-opening acute angles of the corresponding folds above described. The upward-opening angles are never mineralized. In the joints and slips near the pockets stringers occur, while the pockets make more within the brecciated matter toward the vertex of the angle. A highly distorted and ruptured area is an excellent indication of the nearness of ore, while lack of distortions in the beds will permit the elimination of considerable ground from further prospecting and exploration.

Theory of the Ore Deposition

That the mercury salts have been interrupted in their ascension by these closed angles and folds is evident. The lessening pressure and temperature which must have been common in these localities; the crushed and fissured condition of the rock, offering numerous points for the initiation of precipitation and the diffusion of the solutions or gases; the presence of the natural precipitant in the carbonaceous impurity in the limestone; and the trap formed by a fold or an angle with its impervious capping of gouge; are factors any one of which might alone indicate deposition in these places.

There are absolutely no vein, gangue minerals, or other economic minerals than mercury found. The slips, joints and narrow fissures from the insignificant local adjustments of weight and tension have been cemented by calcite leached from the rock itself; a very small amount of pyrites and gypsum now and then may be noted along the slips or in the gouge, doubtless a re-precipitation of leached constituents from the limestone. No silica, salts of other minerals, sulphur, primary calcium minerals, or evidence of the presence of carbonic acid and hydrogen sulphide accompany the mercury minerals.

Two important negative conclusions and one affirmative are logical determinations from the above: viz., (a) inasmuch as no salts of metals, and particularly silica, accompany the mercury salts, nor has any cementation taken place except from leached matter within the zone of deposition, it follows that the deposit of mercury is not due to any precipitation from uprising solutions; (b) for the same reasons, together with lack of alteration in the limestone and impregnations of mercury outside of the area already described, and want of any metamorphic action, a precipitation from gaseous mineralized solutions is precluded also; and (c) the presence of pure salts of mercury unaccompanied by any foreign material and these mercury salts the one foreign material present in the limestone, certainly at least strongly indicate that the mercury reached the zone of the present workings as a gas, and that gas probably of a pure mercury salt, i.e., in the state of a sublimate.

The carefully studied geology of the Central Plateau—not usually complicated as to its elementary features—and familiarity with the vast mining operations general throughout this section demonstrate that here the deposits of ores are always accompanied by one or more of the common gangue minerals, always two or more economic minerals, and often particularly in the case of mercury deposits, with appreciable quantities of

complex sulphides or their oxidized products—all intimately related with eruptive rocks in their genesis; therefore, it is very probable that the mercury deposits of Dulces Nombres were originally laid down at some distant locality accompanied by certain usual gangue and also, perhaps, economic minerals; and that some later dynamical action has caused the initiation of the migration of the deposit as a whole, the mercury compounds due to their comparatively low critical temperature having been the first to advance into a higher horizon, while the continuance of this migration to embrace the other minerals was interrupted, or else their deposition has occurred from gaseous solutions from greater depths.

The quicksilver is found usually as the sulphide, cinnabar, but not of uncommon occurrence is native mercury, presumably oxidized from the sulphide.

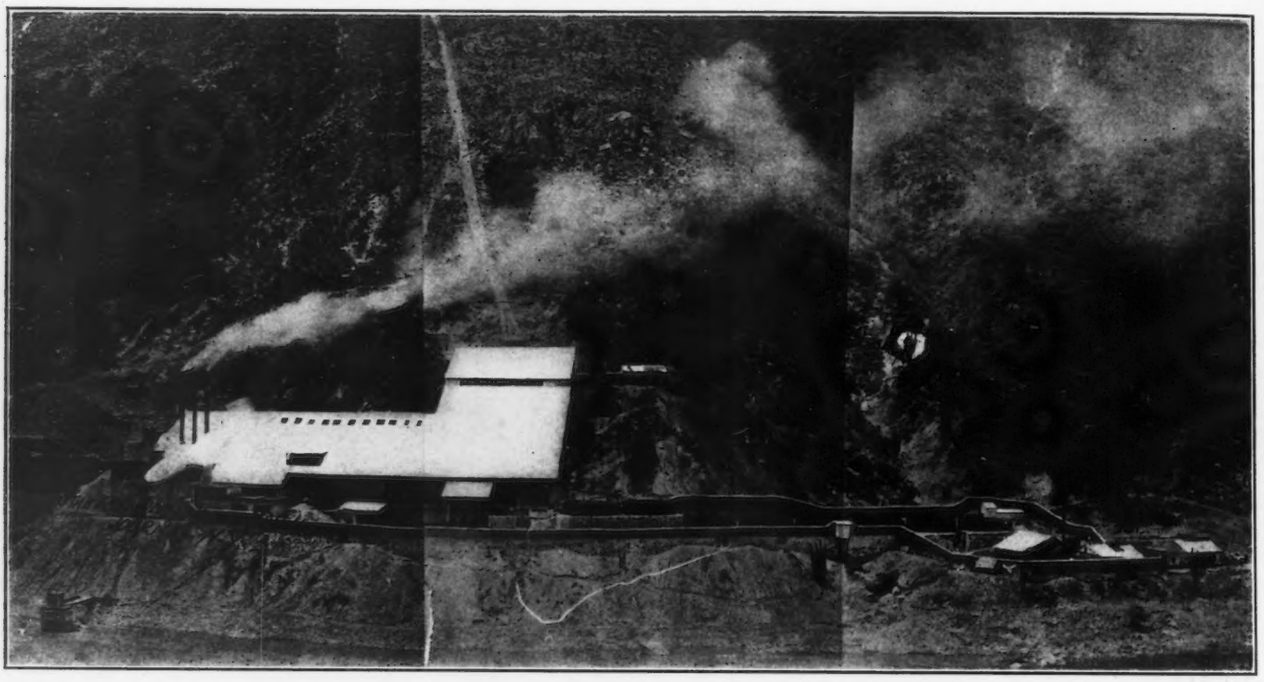
In the vicinity of certain workings known as the *abra* there is a highly fractured vertical zone which has been subjected to an intense oxidization, resulting in the formation of several interesting and rare mercury minerals; a considerable amount of native mercury; calomel or horn quicksilver, occurring in colorless crystals and white earthy masses; the oxy-chloride, terlinguaite, occurring in earthy masses of canary yellow and greenish-yellow colors, crystallizing in the isometric system, and here found for the first time in Mexico; the oxy-chloride, eglestonite, occurring as yellowish-green powder, crystallizing in the monoclinic system, and here found also for the first time in Mexico.

Mining Treatment and Methods Used

The mine workings are concentrated in a contiguous series of several beds of the limestone, extending along the strike some 400 m. and attaining a depth of about 100 m. To the north and south of the present workings there are 1000 m. of promising unexplored ground, and to the east surface indications of distorted and folded rock would seem to justify attention in this direction. Because of the widely separated and small bodies of high-grade ore, averaging as broken in the mine from 3 to 15 per cent. Hg, exploration costs are high.

The total mine operating costs average in the neighborhood of 40 pesos per ton of ore, and smelting 3½ pesos. An expensive amount of exploration work is avoided due to the probable presence of ore being indicated by the highly distorted areas in the rock serving as an excellent guide. The ore is readily distinguished from the limestone, and its extraction is thus facilitated. The rock is rather hard to drill, but on the other hand breaks well.

The company has installed a smeltery of 5 tons capacity per 24 hours. It is constructed of brick, the parts subject to intense heat being of high-grade fire-brick. The ore is fed into the furnace through a hopper, and spread out as a shallow bed from which the hot gases of combustion of wood fuel liberate the metallic contents in volatilized form together with a small quantity of sulphurous gases and these gases then pass from the furnace to a series of external upright iron pipes, set in tubs of water and air-cooled. The mercury condenses in the pipes and is collected in the water traps as exceptionally pure native mercury, due to the entire absence of any deleterious foreign matter in the ores. A 90 per cent. recovery is being made, but with more experience with the practice and minor improvements about to be made, the management expects to make a 92 to 94 per cent. recovery. The only preparation given to the mine-run of ore is to crush the larger pieces so all will pass a 1.-in. ring, and to mix the high-grade with low-grade dump ore of a commercial grade to effect an average tenor in the charge of approximately 2½ per cent. Hg. Placed at the furnace and crushed to 1-in. mesh, ores of ¼ per cent. mercury pay for smelting and marketing.



VIRGINIA-MEXICO MILL; SAND PLANT AT RIGHT, SLIMES PLANT UNDER COVER

Ore Treatment at the Virginia & Mexico Mill, Jalisco, Mexico

By Jesse Scobey*

The ore treated at the Virginia & Mexico mill is assembled from four different mines at a point 1000 ft. above the mill, where it is sorted and lowered by means of a 2-track gravity incline plane, with ½-in. cable, in 2-ton cars, automatically discharging into the mill bins, from which it is drawn over grizzlies to three 10x7-in. Blake rock breakers operated in one unit by one 30-h.p. motor. The crushed ore

*General manager, Virginia & Mexico Mine and Smelter Corporation, Hostotipaquillo, Jalisco, Mexico.

is drawn from masonry bins through challenge feeders to six batteries of 30 stamps operated in two units by 30-h.p. motors each. The stamps run at 109 drops per min., crush in solution, passing five tons per stamp through 12-mesh screen every 24 hours. The ore is fed direct to six Wilfley tables, making concentrates, and acting as classifiers, throwing slimes direct to slimes plant, and sands to two Allis-Chalmers tube mills, 42x16 ft., using local silica pebbles from the Santiago river. Each mill is separately driven through clutch pulley by a 20-h.p. motor. The product goes for reconcentration direct to six additional Wilfley tables which again classify into slimes which go to slime plant, fine sands which go to sand plant and coarse sand returned to the tube mills by two 6x54-in. Frenier sand pumps set in tandem.

Treatment of Sands

The sands go to two 30x6-ft. steel sand-collecting tanks fitted with Butters distributors and central overflow, which separate slime, sent to slime plant, from sands returned to the collector by a 6x54-in. Frenier sand pump. The sand collectors discharge by hand to an 18-in. Robins belt conveyer operated, by a 10-h.p. motor, with an automatic tripper discharging sands to six 30x6-ft. steel sand-treatment tanks; these are discharged by sluicing into the Santiago river. The strong solution from sand treatment goes to one 22x8-ft. steel tank, whence through a 7x8-in. Gould pump to clarifying tanks and zinc boxes.

Slime Treatment

The slimes are raised by two 7x8-in. Gould pumps with ball valves to one 20x20-ft. steel settling tank with clear overflow. The three Gould pumps and one Frenier pump are operated in one unit by one 30-h.p. motor. The clear overflow from the settling tank goes to one 22x8-ft. battery-solution tank, supplying feed water as weak solution to stamps and tables.

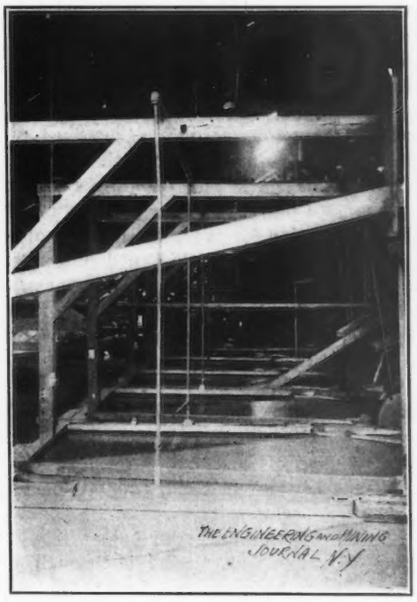
The settled slimes are drawn through a 6-in. pipe to fourteen 15x22-ft. slime tanks, with air agitation and decanting equipment. The treated slimes flow by gravity to one 22x12-ft. Butters treatment storage tank with mechanical agitator operated together with one 14x12-in. air compressor and one 14x10-in. wet vacuum pump by one 30-h.p. motor.

The Butters filter equipment is semi-gravity operated through a 6-in. Butters pump, directly driven by a 30-h.p. motor. The filter proper is a two-hopper steel tank, with 50 leaves, and an acid box with six leaves. The filter is equipped for both air and water discharge. The wash-water tank is steel, 22x8 ft. The solution-wash tank is 22x12 ft. and also built of steel.

Pregnant solution goes to two 26x10-ft. clarifying tanks, steel with cloth filter bottoms covered with sand, feeding by gravity six 8-compartment steel zinc boxes, 24x22x15 in. Barren solution goes to one 26x10-ft. steel tank and is returned to circulation by a 7x8-in. Gould pump. The precipitate is pressed in an 18x18-in. Johnson, steam dried and smelted in a 2-hole furnace using No. 4 crucibles.

Power Equipment

Power is supplied in alternating current by one 200-h.p. generator directly belted to a 15x20-in. 4-valve Atlas engine, and one 100-h.p. generator directly belted to a 12x18-in. Atlas. The two generators acting in synchronism supply 300 h.p. to the mill. Steam is generated by three 100-h.p. high-pressure tubular boilers



INTERIOR OF VIRGINIA-MEXICO MILL SHOWING RE-CONCENTRATING WILFLEY TABLES; BUTTER'S FILTER PLANT IN DISTANCE

fired by wood. Water is supplied from the Santiago river by a vertical centrifugal pump directly operated by a 15-h.p. motor.

P. R. Whitman is mill superintendent, W. I. Winchester master mechanic, George M. Carle master carpenter and concentrator, P. E. Cox electrical engineer, A. F. Solano mill man and Clifford R. Wilfley is chemist, assistant to Mr. Whitman.

The cyaniding patents held by the McArthur Forrest Company in Mexico were declared invalid last December by the Supreme Court of the Republic in the suit brought by the Department of Fomento.

All ores in Mexico are called *metales.* Hence the expression in English "to have good metal" in a mine.

Scientific Treatises as Evidence in Courts of Law*

By William Jago

The practice as to the admission of books as evidence varies in different countries. Short summary of English practice—In criminal cases very little use is permitted, but there is somewhat more latitude in civil actions. The books themselves are not evidence, but a witness may possibly say, "I know this subject, and from my general knowledge I *say* that a certain portion of a book is a correct statement of fact." Examining counsel may not put a book passage to a witness, but cross-examining counsel is at times allowed to do so. This course was permitted in R. v. Palmer. It is open to the objection that the opinion of an absent person is got in without possibility of testing its value. Cross-examination from books has recently been refused both in criminal and civil cases; examples, arguments against, and in favor of admittance of books as evidence.

American views and practice; résumé of arguments by their authorities for and against submission, that the present English rule might with advantage be sufficiently relaxed to admit of the production of scientific books as evidence in the discretion of the learned judge, certain precautions being taken.

Expressions of opinion from a gathering of chemists and lawyers should be of value, as throwing light on a subject in which both are interested, bearing in mind that the proper object of evidence is to provide the Court with the fullest and most authoritative knowledge possible, and so to assist in the administration of justice.

*Abstract of a paper read at the recent Congress of Applied Chemistry at London.

For successful results in copper-plating zinc sheet, according to *The Metal Industry*, use a warm solution consisting of the following: Cyanide of potassium, 6 oz.; regular copper compound, 2 oz.; bisulphite of soda, 2 oz.; water, 1 gal. Use soft sheet copper for anodes, a current strength of 3½ to 4½ volts. A fairly good deposit should be obtained in one-half hour. Blistering results from either too strong a current or too much cyanide. Carbonate of copper can be used in the place of the red copper compound, but use 3 oz. instead of 2 ounces.

Earthwork on the Southern Pacific grade in Jalisco, Mexico, cost the subcontractors from 12 to 16 centavos per cubic meter. The work was done by Indians carrying the material in baskets from the right of way, making a fill of upward 15 ft. in hight.

A Proposed New System for the Cyanide Treatment of Slimes*

By Ferdinand McCann†

Having lately visited cyanide plants in the Republic while gathering data for the book which I have just published on the subject, I was greatly interested by the almost perfect settlement of slimes performed by the Dorr continuous slime thickener installed at the San Rafael mill in Pachuca, and it occurred to me that by extending the field in which this apparatus is at present employed, an entirely new system of cyanide treatment of slimes might be devised.

The elaboration of this idea has resulted in the following proposal of a system which I will call the dilution, in contradistinction to the decantation system of slime treatment. This system consists in the establishment of a series of slime thickeners, following the agitation tanks, with a dilution of the thickened pulp as it enters each successive thickener.

The apparatus which I recommend for the purpose is the Dorr continuous slime thickener, or any apparatus acting on the same principle, not only on account of its marked superiority over cones and spitzkasten as a settler, but also on account of the fact that the tanks and agitating apparatus used in the present installations of mechanical agitation in flat bottom tanks, could by very slight modifications be used as thickener tanks, so that the cost of the conversion of a decantation plant into a dilution plant would be small.

The advantages which I believe may be obtained by this new treatment over the decantation treatment are: *A.* Lower cost of installation, as fewer tanks are required. *B.* Less time required in the treatment, with a consequent increased capacity for a plant already installed. *C.* Less labor, as the manipulation of the decantation pipes is entirely eliminated. *D.* Smaller amount of precious metal in the solution discharged with the tailings, with consequent increased extraction. *E.* The same bulk of solution to be precipitated.

The advantages which may be obtained by this installation in connection with a plant practising mechanical agitation in flat-bottom tanks, with semi-decantation and filtering, comprise those mentioned under headings *A, B, C* and *D*, and in addition there would be: *F.* Greater capacity and efficiency for the filtering plant. The disadvantage in such a plant would be that: *G.* A greater bulk of solution would have to be precipitated. The advantages and disadvantages with plants using Pachuca tanks would be those mentioned under headings *D, F* and *G.*

*A paper read at the July meeting of the Instituto Mexicano de Mines y Metallurgica.

†Mining engineer, American Club, Mexico, D. F.

Method of Working the Dilution System

In order to explain the working of this system let us assume that we have an ore assaying 500 g. of silver per ton, which has been slimed in the ordinary manner and introduced into an agitation tank in the proportion of 50 tons of dry slimes to 150 tons of solution containing 0.3 per cent. KCy, and that the pulp thus formed is agitated continuously for 48 hours. We can assume, according to results obtained in Pachuca by continuous agitation, that at the end of that time, a washed and dried sample of the slimes will assay 70 g. of silver per ton, so that the 150 tons of solution will contain 21,500 g. of silver dissolved from the ore, or 143 g. per ton of solution.

By passing this pulp through a Dorr thickener we will obtain a thickened pulp containing 55 per cent. of moisture. Therefore we will have: (1) an overflow of 89 tons of clear solution assaying 143 g. of silver per ton, and 0.3 per cent. KCy; and (2) 111 tons of thickened pulp, containing 61 tons of the same solution. By mixing this thick pulp thoroughly with 549 tons of barren solution; i.e., 9 tons of barren solution for every ton of rich solution contained in the thickened pulp; we obtain, as a charge for the second Dorr thickener, a dilute pulp composed of 50 tons of dry slimes, mixed with 610 tons of solution assaying 14.3 g. of silver per ton. From this second Dorr thickener we obtain: (3) an overflow of 549 tons of clear solution assaying 14.3 g. of silver per ton and 0.3 per cent. KCy; and (4) 111 tons of thickened pulp, containing 61 tons of the same solution.

By mixing this thickened pulp with 549 tons of water and passing it through a third Dorr thickener, we have: (5) an overflow of 549 tons of clear weak solution assaying 1.43 g. of silver per ton and 0.03 per cent. KCy; and (6) 111 tons of thickened pulp, which as it contains but 61 tons of solution assaying 1.43 g. of silver and 0.03 per cent. KCy, may be thrown away, as it will not pay to extract the material in solution by further handling.

The preceding statements regarding the cyanide contents in the various solutions do not refer to free cyanide, as of course, a certain amount will have combined with the silver, etc. The only precaution required in this treatment is that, in each dilution, there should be a perfect mixture of the thickened pulp with the diluent, as otherwise the dilution would be imperfect, and the thick pulp, in falling to the bottom of the successive thickener tanks, might carry undiluted solution inclosed within its mass.

This mixture might be performed by a centrifugal pump, receiving both pulp and diluent, and throwing them together into a bucket or other small receptacle, which would not only act as a mixing apparatus, but also enable the diluted pulp to overflow without much current into the successive Dorr thickener.

Treatment of the Solutions

The solution (1) should be precipitated, while solution (3) might be partially precipitated, and partially used in the battery, collection—and agitation tanks. But as each 50 tons of ore require 549 tons of precipitated solution for dilution in the second Dorr thickener, we can assume that we would have to precipitate 11 tons of solution per ton of ore treated. This is about the amount of solution precipitated in the decantation plants of the El Oro Mining and Railway Company, and the Dos Estrellas company, before the installation of the filters, so that in this respect there is no difference between the two systems.

The question naturally arises as to what is to be done with the solution (5); as, if fresh water were used in each dilution, the bulk of solution in the mill would soon be too great to handle, and if the solution (5) were used over again, as a diluent in the treatment of the successive charge, it would assay 2.71 g. of silver and 0.057 per cent. KCy; after its third use it would assay 3.82 g. of silver and 0.081 per cent. KCy etc.

This weak solution, after being used once or twice as a diluent, might be used in the battery and collecting tanks, and then its contents could be precipitated before being used again as a diluent, in which way the silver could be kept within reasonable bounds; but the cyanide content would creep up until equal to those of the strongest solution in use in the mill, which, with a 0.3 per cent. solution, would mean that with each ton of tailings discharged there would be a loss of 1.22 tons of solution containing 3.66 kg. of cyanide, thus making the cost of treatment rather high.

However, by using a weak solution of cyanide throughout the mill, say 0.05 to 0.1 per cent. KCy, as is at present done in mills using the decantation process with filter attachment, the loss by this dilution treatment would be within commercial bounds, and would be much less than that sustained under the decantation treatment.

In case this practice were followed, the precipitated barren solution should only be used in dilution of the thick pulp entering into the second Dorr thickener and the direction of pulp entering the second Dorr thickener should be performed by adding solution (5), which overflows from the third thickener, so that the quantity of solution to be precipitated would remain more or less constant, in the quantity of 11 tons of solution per ton of ore treated.

Application of the Process in Connection with a Filter Plant

When the dilution system is installed in connection with a filter plant the third Dorr thickener could be dispensed with,

and the thickened pulp (4) from the second Dorr could be run direct to the filters, where, after filtering, it could be washed with the small quantity or water required to replace that discharged with the tailings, so to keep the bulk of the solution constant, as is at present done in practice.

The advantages of installing this system in connection with a filter plant would be that, on account of the pulp being thick, the cake would be formed on the filter leaves in less time, consequently increasing the capacity of the present filter-plant installation; and also, that the silver content in the solution accompanying the pulp to the filter would be much less than those ordinarily contained, so that the losses which might occur through imperfect washing of the cake would be diminished.

This latter feature is of especial importance in installations where the ore is treated in Pachuca tanks, as in such installations the solutions which are filtered assay from 100 to 300 grams of silver per ton, according to the value of the ore treated, and subsequently it is customary to wash the cake on the filter, first with barren solution, and afterward with water; but even with this double washing the displacement of the rich solution is not perfect, as is evidenced by the fact that the tailings discharged from the filter sometimes carry solution assaying from 8 to 20 grams of silver per ton; so that at present the practice of collecting the wash water in dams, and reprecipitating is giving good results.

By the application of the dilution system, before filtering, the solution which is contained in the pulp delivered to the filter would be of such a low grade that the wash with barren solution in the filter might be unnecessary, as a simple water wash would probably extract all of the values in solution, so that the time occupied in filtering could be reduced one-third, with a resulting increase in the capacity of the present filter installation.

Plant Required

It is customary, in the decantation treatment of slimes, to consider that a tank 30 ft. in diameter and 10 ft. high is necessary for treating 50 tons of ore with 150 tons of solution, as if the pulp is thicker than 1 to 3 there will be little settling and decantation, so that in modern installations for slime treatment by partial decantation and filtering, counting on four days' treatment in the tanks, there are required from 24 to 27 tanks of this size for treating 300 tons of ore per day.

By the dilution system, as there is no decanting in the treatment tank, there would be no reason to prevent charging 100 tons of slimed ore with 140 tons of solution to each tank. Furthermore, as the same extraction is obtained in 48 hours by continuous agitation as in 96 hours by the decanting and settling treatment, the tank capacity for a plant treating 300 tons of ore per day by the dilution system would be as follows: Three thickeners, or agitating tanks used as settlers to dewater the pulp from the batteries; seven agitating tanks, being one extra for the time lost in filling and emptying; three Dorr thickeners for the first dilution; three Dorr thickeners for the second dilution; making a total of 16 tanks, as against 24 to 27 for the same purpose in the partial decantation and filtering plant of the same capacity.

In the older decantation plants, which have no filters, the tank equipment required is much greater than that of the partial decantation and filtering plants above mentioned, as in addition to the agitation plant therein described, there is generally a system of final settling tanks, where the slimes remain for another three or four days, so that there may be required from 20 to 30 more tanks of the same size for that purpose.

These settling tanks would be entirely replaced, in the dilution system, by the installation of three Dorr thickeners, for the third dilution, as the capacity of a 30-ft. Dorr thickener is about 100 tons of ore, contained in 222 tons of thickened slimes, and about 1000 tons of clear solution overflow per day.

Regulating the Quantity of Diluent

It may appear that the regulation of the exact amount of diluent to be supplied to each thickener would be a matter requiring extreme care and attention, but I believe that this would not be the case, as the only result of a slight variation would be that the solutions in the successive thickeners would carry more or less value, which could be regulated by the daily assays. The Dorr thickener works automatically, with very little attention, and would handle sudden changes without any trouble.

An easy way for workmen to judge whether the proper quantity of diluent were being added would be for him to have two cans of different sizes, which he could place under the streams of thickened pulp and diluent passing into the centrifugal pump, to observe whether the cans were filled in the same time, and if not, he could so regulate the valve of the diluent pipe that the time required to fill each can would be the same.

Assuming the specific gravity of the ore to be 2.7, that of the diluent to be 1.03, and the thickened pulp to contain 55 per cent. of moisture, the relative size of the cans required for a dilution of 9 of diluent to 1 of solution contained in the thickened pulp would be in the proportion of 6.87 to 1.

By the ordinary working of the dilution system, as soon as the assays have shown the extraction in any tank to be satisfactory the pulp contained in that tank could be transferred to the first Dorr thickener by means of a centrifugal pump, leaving the tank thus emptied ready for the next charge. But should it be desired, the plant might be arranged for the continuous working of the system. This arrangement, like that of the "Boss" continuous-amalgamation process, might have some advantages, and may be worth investigating. However, it would probably need some special arrangement for transferring the pulp uniformly throughout the agitation tanks.

Conclusion

I wish to state that my interest in the Dorr thickener is purely a scientific one, and I would further state that I do not propose this system as one which has been proved, nor would I advise its installation without having proved it by a preliminary trial on a small scale. I merely offer it as a suggestion to the various metallurgists practicing cyanide treatment, in the hope that the application of the principles herein proposed may be of benefit to them in their work, and that I may be instrumental to a slight extent, in the improvement of the present metallurgical practice.

The Antimony Industry in Mexico

The Mexican antimony industry was developed by M. Elsasser, an American engineer, who for many years controlled the market. Later he became associated with the Cookson interests of London and later sold out to them. A smeltery for the production of star antimony was installed at Wadley on the National Railroad in the northern part of San Luis Potosi about 1900 and practically all of the Mexican ore is now treated there and shipped abroad as metal.

The smeltery is controlled by the Cookson interests, which also have mines or contracts at Charcas, and Catorce in San Luis Potosi, and control the most important antimony deposits in other parts of Mexico. Most of the production is from mines controlled by this interest, as but very low prices are offered for independent ores. Recently several German buyers have appeared in the Mexican field and American interests were attracted there before the Payne tariff increased the rate of duty on antimony ore. There are abundant deposits of antimony in Mexico.

In the laboratories of the General Chemical Company the determination of minute quantities of arsenic in brimstone is performed in the following manner: The brimstone is oxidized by a mixture of three volumes of carbon tetrachloride to two volumes of pure bromine, followed by nitric acid. A little water is added and the nitric acid and carbon tetrachloride removed by evaporation. Arsenic is then determined in residue by Marsh or Gutzeit method.

Electrical Power at Mexican Mines and Mills

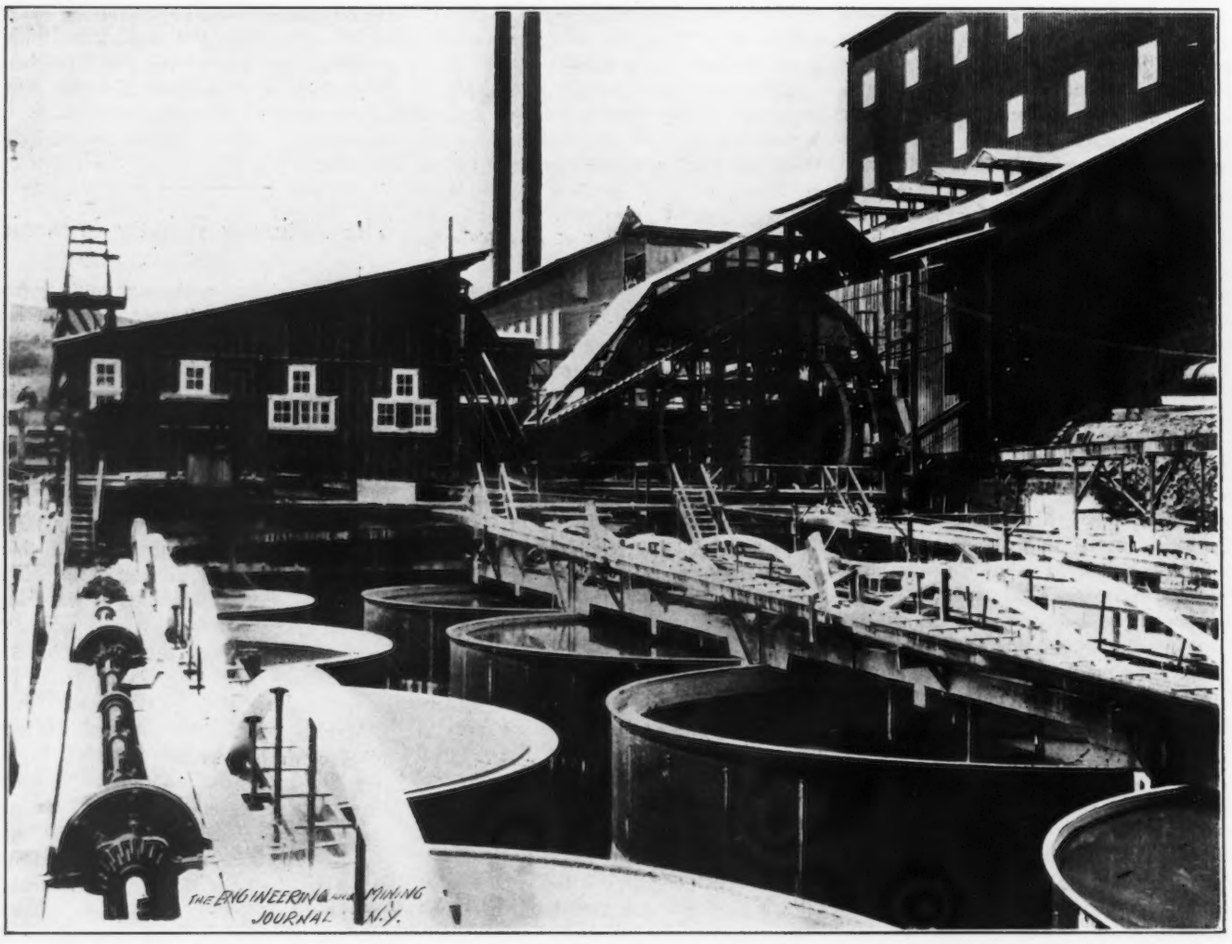
Installation at El Oro 30,000 h.p.; at Guanajuato 21,000 h.p.; Necaxa Power Transmitted 171 Miles to El Oro; Plant with 2950 ft. Head Planned

BY CHARLES V. ALLEN*

The progress in Mexico, resulting in the application of electricity to mining and milling is quite beyond the conception of those unfamiliar with the country's advancement. Not only has Mexico come into prominence through the development of silver cyaniding, but in electrical installations and applications, of which much less mention is made, the country holds no second place with the United States.

Electric power is becoming an essential feature in mining and milling, and its applications and possibilities are often little realized by mining men generally. The setting of steam valves and the lubrication of inefficient steam machinery, with its necessary multiplicities of belt transmissions and resulting losses, is now passing with many mines, and in these days the mine manager finds it very necessary to have a knowledge of volts, amperes and watts, and also to know how to install and properly care for electric motors. While an electrician can be employed to attend to all this, at little expense, nevertheless an acquaintance with these matters on the part of the manager is all important.

All industries which have adopted electric drive have advanced rapidly by improving their product and increasing their output, but the mining and milling of coal and metals has experienced thereby an impetus greater than any other industry. One of the principal reasons for this, and there are also many of a local nature depending on the location of the mine, is the fact that practically all of the drives in a steam-power mine and mill are so readily electrically convertible, the only exception being the steam pump. With many other industries the peculiarity of the drives requires special motors and mechanical speed-changing devices which render the conversion much more difficult. An ingenious mine operator in Mexico has adapted a steam compressor to electric drive by fastening a boiler-plate flange around the flywheel to serve as the pulley to be driven by the motor. Steam hoists, so long as they are not of the first-motion type, and there are few such, are readily changed to electric drive with very little expense; in fact I know of none in Mexico which have been abandoned and new electric hoists purchased unless the original steam hoist was too old to continue in service.



EL ORO CYANIDE MILL, DRIVEN BY MOTORS UNDER BOARDWALK

*Electrical engineer, Apartado 303, Mexico, D. F.

Mexicans Favorable to Electrification

The conditions in Mexico are much the same as in the western part of the United States, where fuel is expensive and water power available. The ordinary industry can be located where cheap power can be had. With mining, however, the conditions are different, as power must be supplied where the mine is. In earlier days water powers were used direct for driving mills where the conditions allowed them to be located within a reasonable haul from the mine. Nature seems to have provided for but few such installations, but with modern methods the possibility of transmitting electric power to great distances permits the mill to be located at the mine, where generally a desirable site for this purpose is available.

Formerly steam was the usual source of power, with wood as fuel, with the result that the wood has had to be hauled greater and greater distances until the cost has rendered further working prohibitive, resulting in the shutting down of many Mexican mines. This has opened an excellent field for electric power. The class of load common with mining customers is particularly desirable to power-transmission companies as it is especially steady, being 24 hours each day, and every day in the year.

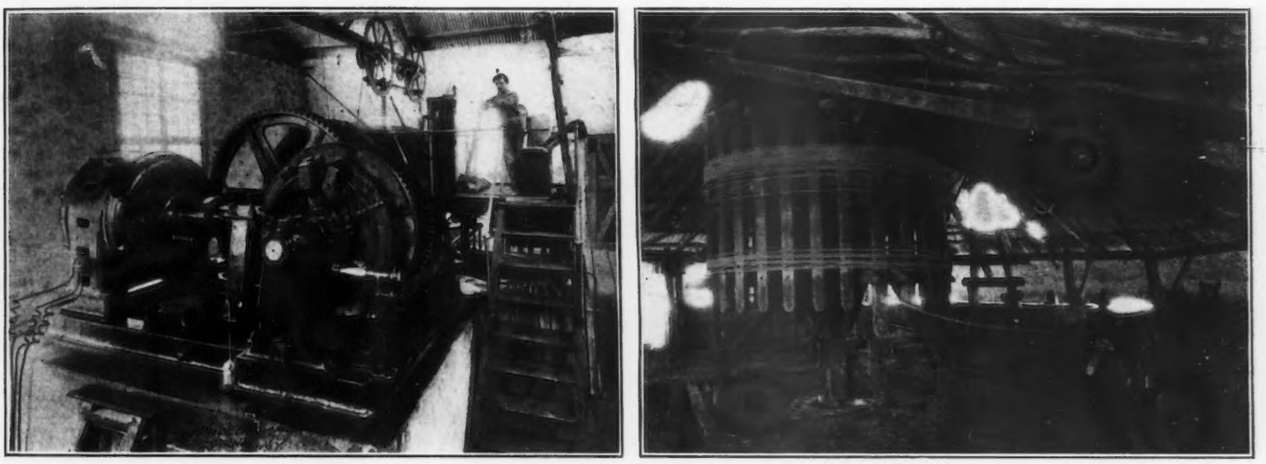
The fact that mining is so important in Mexico's industries, as well as the fact that the cost of fuel in most of the mining camps has become prohibitive, is doubtless responsible for the extensive adoption of electric power. In the mining and extracting of the metals, everything which can reduce the cost must be considered in order to make profitable the low-grade properties, and inasmuch as power is one of the chief sources of expense in Mexico, a country where labor is comparatively cheap, it is fortunate that the ample water powers in this mountainous country can be utilized to their utmost. This is being done, as reference to a few of the installations which have brought about vast changes in the mining industry of this country will show.

Guanajuato Camp Revived

Five or six years ago the Guanajuato mines were, with but one exception, abandoned on account of the inability to operate them due to the high cost of fuel for power purposes. They could no longer be kept unwatered, and the ore economically handled by the crude methods employing horse whims or *malacates*. The Guanajuato Consolidated Mining and Milling Company, however, was operating extensively and with this power customer in view, and for the lighting of Guanajuato, the Guanajuato Light and Power Company constructed a plant, which ultimately amounted to 8000-h.p. capacity, to generate electricity from water power and transmit it a distance of 110 miles to the Guanajuato camp. Today we find that in order to keep up with the large demand for power this company has installed two other power plants for 3000 and 10,000 h.p. respectively, making a total generating capacity of 21,000 h.p. Between $40,000,000 and $50,000,000 has been invested by Americans in the camp in the last five to six years. The mines with low-grade ore have been made to pay well, and the dumps, formerly abandoned, passed through the mills at a profit. In fact the whole community has been wonderfully revived by the reopening of the old workings, which have developed new strikes of very rich ore; probably the most remarkable of these being that of the Pinguico mines, which would have remained uncovered except for the advent of cheap electric power.

El Oro the Largest Consumer

The largest electric-power consuming mining camp in Mexico is El Oro. This camp receives its power from Necaxa, 171 miles away; it is transmitted at 60,000 volts at present, but this is to be raised to 80,000 volts soon. This has been found necessary on account of the demand exceeding any anticipation. In fact the power demands in all the mining camps have exceeded all original expectations. The power consumption in El Oro at present amounts to some 10,000 k.w., with over 30,000 h.p. of electrical machinery installed. This camp differs from Guanajuato in so far as there are a few large consumers instead of a large number of smaller consumers. The cost of power is from one-half to one-third of the former cost by use of steam. As a result the mines have increased the output and so reduced operating expenses that large accumulated piles of tailings, from which all the values have been extracted, so far as economical practice allowed with the former cost of power, are now being reground in tube mills and again treated by cyanide. Over 4500 h.p., requiring 50 electric motors alone, is used by the four large companies for hoisting in this camp. Thirteen electric locomotives are in service; the largest, 30-ton, being used on a 3.8 per cent. grade, is the first in Mexico to replace steam locomotives. Constant-speed motors are employed up to units of 600-h.p. capacity, and hoist motors up to 400 horsepower.



DOUBLE DRUM ELECTRIC HOIST, GUANAJUATO AMALGAMATED GOLD MINES AND THE MALACTE IT DISPLACED

Extensive Use of Electric Power in Pachuca

One of the most prominent camps, and one of the first to adopt electric power and make use of it universally was Pachuca. A large amount of electrically driven mining and milling machinery has been and is being added to mines in this district. This power is supplied by the Cia. Electrica é Irrigadora and the Cia. de Transmisión Electrica de Potencia. Until recently the former company's first installation, which comprised six generating units, and started about 10 years ago, was sufficient to supply the demand, but within the last two years it has added two more plants, with a fourth under construction. All of these plants use water from the

same river and the power is transmitted at 25,000 volts over two separate circuits to Pachuca. The largest principal consumer at present is the Cia. Real del Monte y Pachuca, which consumes about 4000 h.p. The Cia. de Transmisión Electrica de Potencia has also added two other power plants since the original installation.

Electrical Power Is Being Generally Introduced

Mention might be made of Oaxaca, Parral, Chihuahua, Durango, Zacatecas, Temascaltepec, Sultepec and many other mining camps, where electric power is used to a greater or less extent.

With the greater part of the mining operations of Mexico, situated as they are from 4000 to 7000 ft. above sea level, the rivers running to the east and west coasts create ideal water powers capable of inexpensive development. In many cases there are streams where there are available heads up to 3000 ft.; a power project recently surveyed has 2950 ft. head available.

In many of the camps where expensive fuel prevails, and the haul to market of the ore is also expensive, the ore must run 50 to 60 pesos to the ton, and even more in some places, to pay for shipping. This results in much low-grade material going over the dumps after the richer ore has been sorted out. Naturally the remedy for this is a mill or a smeltery on the ground, or a railroad to reduce the cost of transportation. The latter is usually impossible, on account of the inaccessible location of the mines; and, furthermore, would not be of so much help except in the case where smelting ore was being mined. Whatever the class of ore being mined, cheap power at the mine is essential, all the more so if it be a milling ore of low grade.

As a result of the conditions in Mexico, electric power will play a more and more important part in the progress and expansion of mining, and already it is one of the essential factors in the development of the industry.

Classification of Mexican Ore Deposits

A tentative classification of the ore deposits of Mexico is submitted by E. Ordoñez, mining geologist of Mexico city. It is as follows:

(1) Veins in more or less propylitized eruptives (andesites, dacites, porphyrites, etc.). Under this heading belong the greater number of the deposits of the Sierra Madre Occidental and some on the Mesa Central. Excellent illustrations are furnished by Pachuca, Huatla, Angangueo and Parral. Sulphides of silver are the chief ore and the gangue is mainly quartz and calcite. Gold is sometimes the principal metal. The silver is always accompanied by sulphides of other metals, such as lead, copper and zinc.

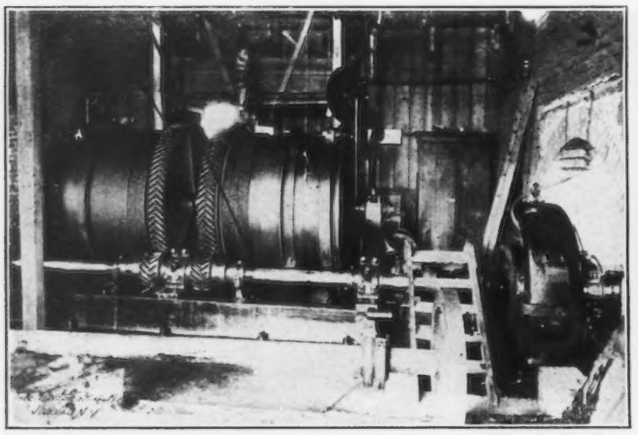
(2) True veins between walls of clastic rocks which have been metamorphosed by intrusives, and both of which have been faulted by tectonic movements before the introduction of the vein filling. These deposits are frequent in the central part of Mexico, such as Taxco, Zacualpan, Sultepec, Tlalpujahua, Providencia, Guanajuato and Zacatecas. Silver is the principal metal produced, but, as in type No. 1, it is often associated with gold and other metals named.

(3) True veins with quartz gangue, occurring solely in thinly stratified clastics, and without certainly demonstrated connection with intrusive rocks, even if in the immediate vicinity of eruptives. They are frequent in the central part of Mexico, and good illustrations are El Oro, Pozos and Temascaltepec.

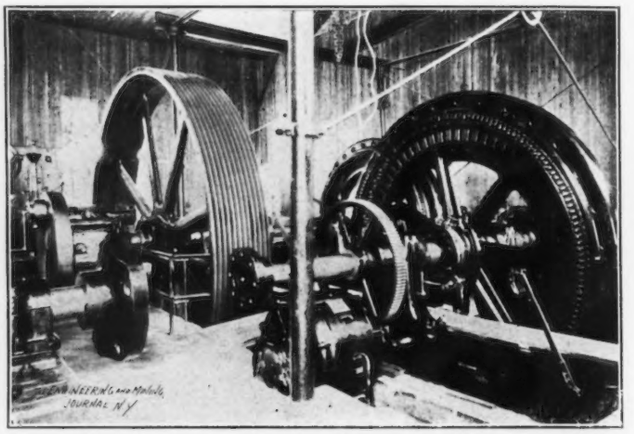
(4) Segregated veins in effusive rocks and even at times in intrusives. The best illustrations are furnished by the deposits of tin and a few of iron.

(5) Contact deposits between limestones or clastics and intrusive rocks such as granites, monzonites, diorites and different varieties of porphyries. The intrusives sometimes cut across the stratification, again are laccoliths, or they may form the axial core of long ranges of Cretaceous sediments. At other times the mineral deposits appear in connection with dikes, not only in Mesozoic limestones, but also in the Archean and Paleozoic strata of the southern and the northwestern portions of Mexico. These contact deposits are the chief producers of copper and iron in Mexico. The great copper mines at Cananea belong to this group, as well as most of the orebodies in the Sierra Madre Occidental, and of the interior and northern portions of the Mesa Central. While the larger portions of these deposits yield copper or iron, yet there do not fail those with lead or zinc, or even of gold in association with copper. Good illustrations are furnished by San Carlos in Tamaulipas, Sierra del Carmen, Golondrinas, Mazapil, Encarnacion, Las Vegas, Aurora, Balsas, Cerro de San Pedro, Campo Morado and many more.

(6) Deposits in cavities or caves in limestone and replacements in limestone, with or without connection with intrusive rocks. This group embraces all the important orebodies yielding lead, zinc, antimony and mercury and a few with copper. Illustrations are provided by Norias, San Juan de Guadalupe, Sierra Mojada, Santa Eulalia, Naica, Amoles, Zimapan and others.



STEAM HOIST CHANGED TO ELECTRIC, EL ORO



SYNCHRONOUS MOTORS DRIVING STAMPS AT EL ORO

Mexico in 31 years has produced, according to the statistics of the Mexican mint, over $1,000,000,000 of gold. During that period the gold output has increased from $13,300,000 to $62,271,000 for the last fiscal year, 1908-09.

Tungsten is found in several localities in Mexico, but the product is very limited, only one mine in Sonora having made any shipments. Deposits are reported from Oaxaca, San Luis Potosi and Guerrero.

The figuring basis in Mexico for gold and silver content is one gram of gold equals 1.329 pesos and one gram of silver at the New York price of 50c. an ounce equals 3.2 centavos.

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*Illustrated.

The Mineral Production of Mexico

Owing to the incompleteness of the Mexican statistics of production, we are unable to give any thoroughly satisfactory table. Exports may, however, be taken as indicating the condition of the mining industry. We owe the statistics for 1908, together with a complete revision of Table I (from THE MINERAL INDUSTRY, Vol. XVII), to the courtesy of Don Miguel M. Irigoyen, chief of the Section of Statistics, Secretaria de Hacienda y Credito Publico.

From data in THE MINERAL INDUSTRY, Vol. XVII, we have compiled Table II, which enumerates the principal items of Mexican mineral production, with the exception of coal. In the case of zinc ore the statistics are but partially complete, inasmuch as they represent only the receipts of smelters in the United States, while European smelters have taken considerable quantities during the last two or three years and the real production of zinc ore in Mexico is probably 10 or 15 per cent. more than our table shows.

The most striking feature of the statistics of Mexican mineral production is the increase in recent years in the output of the base metals and non-metallic mineral substances. In an article published elsewhere in this issue Doctor Raymond and Mr. Ingalls point out that the history of four centuries in America, North and South, emphasizes a great principle, namely, that while mining in new regions is originally inspired by the desire to obtain the precious metals, no permanent mining industry is established, and no substantial development is secured, until the mining of the base metals and of the bulky minerals, especially coal, is begun, "Precious-metal mining is characterized by the ephemeral camp; base-metal mining is distinguished by the growth of permanent towns, often cities, and an enduring population. This has been the history of the United States; it is becoming the history of Mexico."

I. MINERAL EXPORTS OF MEXICO.
(In metric tons or pesos.)

Year.	Antimony.		Coal.	Copper.		Gold.			
	Metal	Ore.		Ore.	Ingot.	Ore.	Bullion.	Specie.	Precipitate.
1895	.....	600	61,686	3,006	20,429	P. 103,773	P.4,920,504	P. 175,098	P34,257
1896	.....	3,261	75,541	144	20,659	206,874	5,533,789	261,078	206,674
1897	.....	5,873	105,298	1,094	16,858	365,226	6,220,765	202,223	206,902
1898	.....	5,932	118,553	13,146	10,362	1,037,202	6,493,735	367,704	358,791
1899	.....	10,382	113,192	223	25,293	335,849	7,017,286	183,474	382,743
1900	.....	2,313	38,676	408	27,970	306,392	7,435,864	192,456	305,868
1901	.....	5,103	17,281	5,576	33,818	284,722	8,324,681	210,431	260,547
1902	1,218	1,280	3,406	6,101	63,609	303,979	9,079,371	129,899	118,953
1903	2,304	7,302	1,840	10,912	51,716	264,503	9,693,692	54,636	209,485
1904	1,694	81	125	48,365	57,338	537,290	10,867,272	172,532	255,219
1905	1,978	57	497	92,540	56,634	1,513,344	29,636,117	106,470	535,847
1906	2,418	178	91	73,193	46,767	5,369,173	21,072,014	37,746	517,642
1907	4,615	681	1,532	115,245	51,519	3,033,090	19,653,362	5,023,404	915,055
1908	4,046	36	719	70,900	26,214	2,746,289	30,101,546	42,389	479,903

Year.	Graphite.	Gypsum.	Lead.		Silver.				
			Ore.	Base Bullion.	Ore.	Bullion.	Specie.	Precipitate.	Slag.
1895	794	1,340	568	50,122	P.10,977,079	P.22,178,294	P.18,300,553	P. 570,124	P72,590
1896	795	2,050	167	48,663	9,971,053	28,565,843	18,737,331	1,533,355	64,121
1897	759	2,095	2	60,029	11,401,176	35,775,125	21,925,347	1,786,827	39,800
1898	1,365	1,650	(b)	60,918	11,048,358	37,137,599	16,588,789	1,920,843	46,488
1899	2,305	1,050	1	67,441	10,766,099	37,585,911	5,580,834	2,006,027	4,810
1900	2,561	1,600	468	79,944	12,495,524	41,468,745	22,679,655	1,961,253	87,883
1901	762	800	(b)	79,097	9,615,939	36,348,374	12,038,158	2,400,967	93,549
1902	1,434	(b)	118	107,366	4,108,088	45,796,576	17,753,526	2,087,263	132,093
1903	1,404	(b)	11	100,532	11,781,048	48,276,797	16,167,673	1,778,188	289,900
1904	970	(b)	1	95,010	11,000,869	45,430,020	7,251,132	1,563,808	202,594
1905	970	27	1	101,196	8,505,834	63,564,789	20,335,297	1,174,322	29,012
1906	3,915	(b)	(b)	73,699	9,619,763	63,057,152	42,390,357	1,029,997	(b)
1907	3,202	(b)	11	76,158	11,396,844	68,187,169	23,848,571	1,268,754	785,116
1908	1,076	(b)	26	127,010	11,230,372	63,298,659	60,405	860,546	(b)

(b) Not reported.

Up to a quarter of a century ago, Mexico was known chiefly as a producer of silver, besides a comparatively little gold. In recent years it has attained a position among the world's greatest producers of copper and lead, and lately has been achieving eminence as a producer of antimony, zinc ore, and petroleum. It is these bulky substances that furnish traffic for the railways and constitute the basis of a permanent mining industry. Let us take up some of the branches of Mexican mining, subject by subject.

Antimony—For 15 years or more, Mexico has been a producer of antimony ore. In the earlier years of this industry, all

of the ore was exported. Beginning with 1902 smelting in the Republic was inaugurated, and since then the exportation of antimony ore has dwindled to insignificance, while the output of antimony metal has attained such proportions as to put Mexico in the premier position among the world's producers of this substance.

Copper—Among the copper producers of the world, Mexico now ranks next to the United States, its normal output far exceeding that of Spain and Portugal. In 1908 the Mexican production was materially below the average owing to the suspension of operations at Cananea, pending reconstruction of works, etc., during the early part of the year, but in 1909 the Republic will no doubt regain its former position and will continue to forge ahead in the production of this metal. By the introduction of methods of improved mining and the modernization of its smelting works, the management at Cananea now expects to be able to compete successfully with the other big copper-producing companies of North America. After Cananea, Boleo is the largest producer of copper in Mexico, Aguascalientes next, and then Nacozari, although the latter probably will be rivaled by Teziutlan. There are in Mexico several deposits of copper ore that are believed to be large, such as those at Inguaran, in Michoacan (owned by the Rothschilds of France), which only await the advent of railways to become important producers.

Gold and Silver—The large increase in the production of silver in Mexico in 1908 was due to the increased application of the cyanide process, which has become the greatest feature of interest in Mexican metallurgy. With the further extension of the use of this process, the output of silver in Mexico will doubtless gain materially in spite of a continuance of price at the 50-cent level. Along with the increased production of silver there is a larger production of gold, inasmuch as most of the ore that is preëminently valuable for silver contains more or less gold which is recovered at the same time.

From the earliest application of the cyanide process in North America, it was well known that many kinds of silver ore were amenable to the solution used chiefly for the extraction of gold. It was indeed considered to be one of the great advantages of the cyanide process over the chlorination process that the former could extract the silver content of gold ores, which, of course, could not be done by chlorination. As early as 1895 the cyanide process was applied to the treatment of a straight silver ore in Nevada, the product being a silver precipitate that was melted into bars of the white metal. It remained, however, for metallurgists to make the great and general application of the cyanide process to silver ores in Mexico, and this has now become a branch of metallurgy that Mexico may properly claim for its own.

Lead—The chief lead-producing districts of Mexico are Mapimi, Santa Eulalia and Sierra Mojada. Mapimi, owned by a close corporation, is one of the most profitable enterprises in the Republic. Sierra Mojada, famous as a district, is no longer what it was in its pristine days. On the other hand, Santa Eulalia, which is one of the famous old districts of Mexico, is showing new developments of extraordinary character. Naica, a new district (developed since about 1900) is also figuring as an important producer of lead ore.

Petroleum—Ten years ago it was scarcely dreamed that Mexico would ever be a producer of petroleum, but during the last two or three years it has become famous by some extraordinary "gushers." Production was inaugurated in 1907. In 1908 important developments were made in the industry, and production practically doubled. Explorations, conducted at widely separated places, seem to indicate that a large territory, bordering on the gulf of Mexico, is underlaid by oil. Although the industry is still in its initial stages, the existence of oil in large quantities has been proved, and Mexico may be expected to figure largely as a producer within a few years, furnishing at least enough of this fuel to supply all domestic requirements, even though insufficient to make the Republic an important factor in the export trade. For the most part, the wells now producing furnish a heavy variety of oil with an asphalt base. Although not possessing the refining qualities of the lighter oils, the petroleum has been found to be valuable on account of its by-products.

Zinc Ore—Since about 1904, Mexico has been a producer of zinc ore, and in 1906-08 the mining of this substance attained large proportions, chiefly owing to the requirements of the smelters in the United States, whose supply from home sources was deficient. The recent imposition of a heavy import duty on zinc ore sent into the United States has been a serious setback to the industry in Mexico, which is now practically limited to the European market, where the price for spelter did not average so high as in the United States even before the recent tariff changes. The situation in the zinc industry of the world is at present greatly confused by the radical fiscal chances in the United States, wherefore it is doubtful what will be the result for the zinc industry in Mexico. Plans for zinc smelting in Mexico are being discussed, but so far they do not appear to be attractive or promising.

II. MINERAL AND METAL PRODUCTION OF MEXICO.
(In metric tons or kilograms.)

Year.	Antimony, Met. Tons.	Copper, Met. Tons.	Gold, Kg.	Graphite, Met. Tons.	Lead, Met. Tons.	Petroleum Met. Tons.	Quicksilver, Met. Tons.	Silver, Kg.	Zinc Ore, (*b*) Met. Tons.
1905.....	1,978	65,449	24,236	970	101,196	.....	190	2,023,418	29,173
1906.....	2,414	61,615	27,889	3,915	73,699	.....	200	2,130,638	80,632
1907.....	4,615	57,491	28,108	3,202	76,158	294,000	(*a*) 200	1,901,934	98,681
1908.....	4,046	38,190	36,779	1,076	127,010	587,000	(*a*) 200	2,258,080	65,309

(*a*) Estimated. (*b*) Receipts of smelters in the United States.

When the directors of a mining company indulge in the practice of swelling apparent profit by charging various expenditures to capital account they soon find that the latter may become a very elastic and convenient quantity. However, it is necessary to sink shafts and drive drifts to get at the ore and it is proper that they be charged to the ore. If charged to capital account, as we have known it to be done, a drift may disappear in the extraction of the ore and continue to exist only in the capital account of the books. When a shaft is reckoned as an asset it is assumed that it will be still valuable after all the ore has been removed. This is not often the case. If shafts and adits were really assets, how valuable the Comstock would be! With mining companies, even more than with other industrial enterprises, the only safe rule is to charge to capital account only actual additions of productive property.

Details of Practical Mining

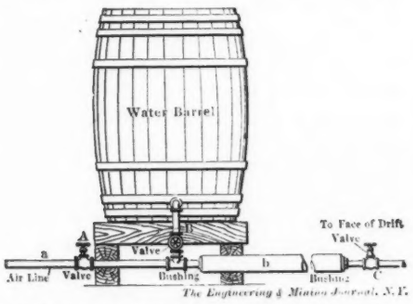
Notes of Interest to the Operators of Small Mines as Well as of Large Mines. The Things That Have to Be Done in Everyday Mining

REPORTS FROM EXPERIENCE

Readers of the JOURNAL are invited to contribute to this department. Articles should be brief, thoroughly practical, and preferably illustrated by drawings or sketches. Our draftsmen will prepare properly any kind of a pencil sketch that is intelligible. Something that is an old story in one district may be quite unknown in another. Articles accepted and published are suitably paid for.

Scheme for Ventilating the Working Face

In order to spray muck piles at the face of ill-ventilated drifts and assist the ventilation in a less wasteful manner than by "blowing out" the drift with air from the drill-supply line the apparatus shown in the accompanying drawing has been adopted at several large mines. A pipe



WATER AND AIR-LINE CONNECTIONS FOR SPRAY

connection is provided from a water-supply barrel to the air line *a*; this air line is enlarged at *b*. To spray the muck shot down the valve *A* is closed and water run into *b* by opening valve *B*. The air is then turned on, after *B* has first been closed again. In this way much less air is consumed than by the ordinary method of blowing out, and the water absorbs the gases contained or held by the muck.

Tail Rope Haulage Operated by Skips

At the Republic mine, Michigan, where an unbalanced ore skip is being used, the descending skip furnishes power for hauling empty ore cars. The tram has a length of 900 ft., and has a sufficient down grade for the loaded cars to run out by gravity. The car is of the double-truck type, side dump, weighs 6500 lb. and carries 3½ tons of ore. A tail rope is attached to the car and is connected with a winding drum on the axle of the sheave. This drum is 8 ft. in diameter, the same as the sheave. A friction clutch is used to operate the drum. There is also a brake on the drum to control the speed of the outgoing cars. Both brake and friction clutch are operated by a wire rope from the station level. An indicator is also used to show the exact position of the car on the track. The car dumps automatically. Of course in this particular case the skip remains at the surface until the car has reached the bin and is ready for its return trip. As the skip descends, the friction clutch is thrown in, and the empty car is drawn back to the shaft ready to receive the ore when it comes up. This scheme works excellently with a shaft that is not working at its full capacity or where the stopping of the skip for a few moments does not interfere with the output. A second drum is now being installed at the same mine. This one will only be 4 ft. in diameter, as the distance for tramming the ore is less.

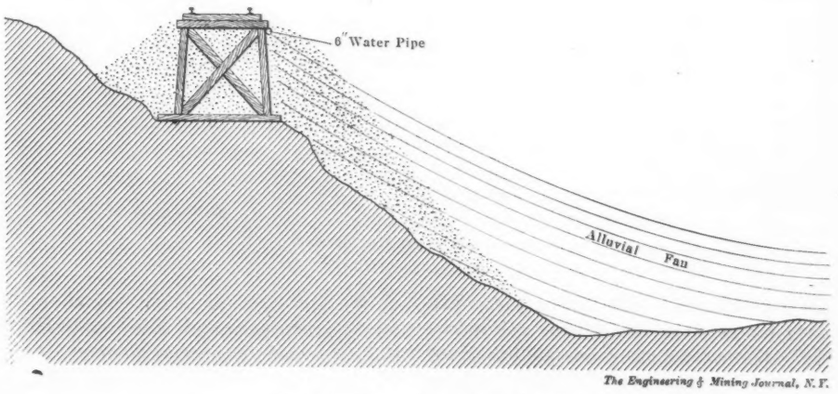
In a system of counterbalanced skip a similar scheme is used, except that the ascending skip also brings in the empty cars. In this case the loaded car goes out as the skip descends and then returns as the skip comes up. The drum is at the station level and is operated by a rope drive from the sheave. The drum, as before, is provided with friction clutch and brake. This of course adds a little extra strain on the hoisting cable, but it is not enough to affect seriously its working.

Disposal of Waste

In the stripping of the large ore deposits on the Mesabi range, the disposal of the overburden is one of the large problems that has to be solved. In most cases this waste material is hauled from one to two miles in side-dump cars and emptied over the side of a dump, 50 to 100 ft. high. The shifting of the standard-gage track to keep up with the growth of the dump is a matter of considerable expense. In nearly all cases this is accomplished by hand labor. At one or two mines it is done with the wrecking car by simply attaching four chains to 30-ft. sections of track, lifting them bodily and setting them over the required distance. At one mine a track shifter is being tried.

Where there is ample room and no danger of damage suits arising, the latest device is to use water to wash the material from the railroad tracks. The necessary requirements are a high bank upon which to build a 15- or 20-ft. trestle, and a deep gulch in which to deposit the dirt. A substantial trestle is constructed and this is filled up to the ties with dirt from the dump cars. Just beneath the ties and on the outside row of posts is placed a 6-in. water pipe with ½-in. holes in one side, 18 in. apart. These holes all open out from the track. The bottom of the trestle is buried sufficiently deep to hold it in place and there is little danger of its washing out.

The material is dumped over the side of the trestle from the cars and the water plays upon it, washing it down the slope to the low ground. In this way the angle of repose for the dirt will be 10 or 15 deg. instead of approximately 40 deg. In



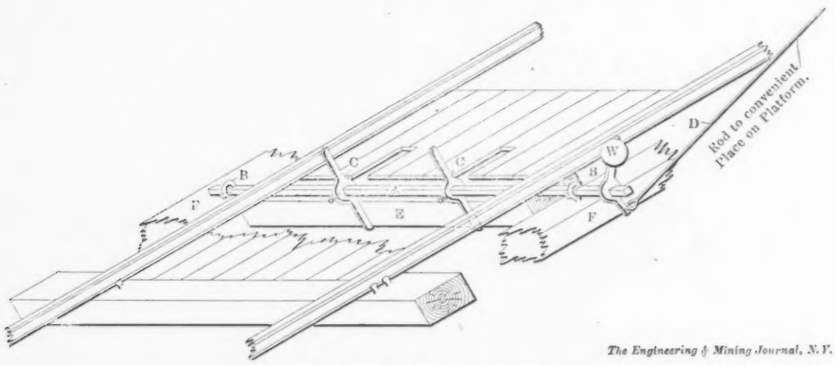
DISPOSAL OF WATER BY SLUICING

the case under consideration the track is about 75 ft. above the side of a small lake. This flat alluvial fan will extend out a long distance and add largely to the capacity of the dump. In this way a solid track can be maintained and it need only be moved once in many months, whereas, in the usual way it is necessary to shift the track almost daily. The shifting operation is expensive and in addition the track is always in bad condition. In the accompanying illustration, the dotted portion represents the waste that could ordinarily be dumped from the trestle, while the inclined lines to the right indicate the amount that may be disposed of by using water from the pipe which parallels the track.

Gate for Use in Incline Shaft

By A. H. Sawyer*

The contrivance shown in the accompanying drawing consists of a 2-in. iron bar *A* working in bearings *B B* fastened to the timbers *F F* which are, in turn, fastened to dividings not shown. Crossbars *C C* are held in place on the bar *A* by set screws. The upper portion of these crossbars engages the skip and the lower the timber *E* when the rod *D* is pulled. When the skip is hoisted, the weight *W* causes the bars *C C* to fall back in place. To prevent dirt from clogging the bars the apparatus is planked over.



PLAN FOR GATE IN SHAFT

Breaking Ground for Steam Shovels

Two systems of blasting the ground to be excavated by steam shovels are used in the Mesabi district, Minnesota. The overburden to be blasted is glacial drift, while the ore is soft hematite. Where the bench to be broken does not exceed 20 or 25 ft. in hight, the usual method is to drill holes 15 to 18 ft. from the edge and about 15 ft. apart, extending along the entire bench to be broken. A handle bar is fastened to the drill steel and two men operate the drill by means of this handle. The drill is lifted about 2 ft. and dropped by its own weight. The men walk around in a circle 3 ft. in diameter and in this way turn the drill. When the hole is the required depth (about 20 ft.) one or two sticks of 7/8-in. powder are lowered and discharged to spring the hole. The hole is again opened and 5 to 15 sticks of dynamite are placed in the bottom of the hole and discharged to spring the hole further, so that it will contain 10 to 15 kegs of black powder. When loading the hole with black powder, a stick of dynamite, in which two caps and fuses are inserted, or an electric wire attached, is lowered in the hole and powder is filled around it. After the powder is in place, the hole is firmly tamped with sand. Each hole is discharged separately. During cold winter weather only one hole is discharged at a time, and the loosened material is moved before it has an opportunity to freeze. In the summer often 15 or 20 holes will be fired, one after the other, yielding enough loose material to last the steam shovel several days.

"Gophering"

The other system of loading, called "gophering" is used when the ground is so dry or sandy that the vertical hole cannot be kept open, or when the bench is too high to drill from the top. In this method holes are drilled in from the side. The total depth is 20 to 25 ft. A pointed 1¼ in. drill bar is used. After it has been driven a few feet with hammers, the bar is withdrawn, and sticks of 7/8-in. dynamite are placed end to end in the hole and discharged. This loosens the ground and the dirt is then taken out by means of a long-handled shovel. In this way a hole 10 or 12 in. in diameter is opened. The hole is inclined at an angle of 15 to 20 deg. The lower end of the hole is sprung with 8 or 10 sticks of 7/8-in. powder and cleaned out. Ten to 15 kegs of black powder are then used. The black powder is fed into the hole by means of a box 3x3x15 in., nailed to a 22-ft. slim pole. The box is pushed in and turned over to empty it. Another method of loading is by means of a V-shaped trough made of ¾x4-in. boards. The powder is poured into the upper end, and the trough given a backward and forward motion, and in this way the powder soon finds its way to the bottom of the hole. Two men can usually put in two of these holes per shift. If the ground is loose enough to work with the shovel, it is not necessary to spring the hole before the bottom is reached. However, if it should be a tough clay, it is necessary to spring it. When boulders are encountered, they are broken by discharging dynamite on their face. In case a boulder is too large to break in this way, it is often necessary to start another hole.

Bundling Drill Steel

At the Hamilton shaft of the Chapin mine, where a small number of men are at work as contract miners, the steel is delivered at the surface from the shop. As the miners come out for their dinner, each drill gang selects its drills for the next shift. These are all bundled together and tied with a wire. While the men are out at noon, the steel is lowered and sent to a common distributing center near where the men are working. The majority of the work is by contract, and each contractor's tools are numbered. This saves the trouble of sorting the steel underground where the light is usually none too good. It also facilitates the distribution of the steel. The steel is furnished by the company while the powder, fuse and other tools are charged directly to the miner. At the Ludington shaft where most of the work is now being done, one man is employed whose only work is to look after, collect, and deliver the drill steel to the miner.

Swinging a Boom Pole

The scheme used at the Smith shaft of the Cleveland-Cliffs Iron Company consists of having two pulleys anchored about 100 ft. each side of the boom. At a convenient place, out of the way of the boom, is a windlass upon which a rope winds. The two ends of the rope are attached to the boom and passed over the pulleys making an endless rope. The windlass between the pulleys is operated by one man. There are six turns of rope on the windlass to give it ample friction. The windlass will operate the boom in either direction.

*Keewenaw Copper Company, Mandan, Mich.

Personal

Mining and metallurgical engineers are invited to keep THE ENGINEERING AND MINING JOURNAL informed of their movements and appointments.

Walter Douglas, of Bisbee, Ariz., has been visiting New York.

Harper Sproule has established an ore-testing station at Parral, Mexico.

C. W. Wright is returning to Sardinia to resume his professional engagement there.

Paul Danckwardt has been examining some mines in the Galena district in South Dakota.

Edwin E. Chase has returned to Denver, Colo., after three months' absence in Mexico.

Louis A. Wright, of the General Development Company, has been visiting New York.

Dr. E. D. Peters, who has been making a Western trip, returned to his home about Sept. 25.

Geo. L. Fraser has resigned as manager of the Royal Collieries, Ltd., at Lethbridge, Alberta.

Niels O. Bagge recently arrived in New York from Mexico, and shortly afterward sailed for Europe.

George D. Reid of Denver, Colo., is examining properties in the Snake river region of Oregon.

Alvah B. Carpenter has returned to Los Angeles, Cal., from a professional trip to Zacatecas, Mexico.

Joseph A. Haley, of Boston, has started on a trip to visit copper mines in Montana, California and Arizona.

S. F. Shaw, of Los Angeles, Cal., will be in Costa Rica during October and November making examinations.

C. Colcock Jones arrived at Seattle, Sept. 15, from a two months' trip to the Copper river region, of southwest Alaska.

Chas. H. Rundberg, superintendent of the Dominion Copper Company's mines at Phœnix, B. C., has resigned that position.

A. G. Kuehne and G. Richards, of New York, have been examining the Ferris-Haggarty and Elkhorn copper mines in Wyoming.

Dr. Fayette A. Jones, of Albuquerque, N. M., will be a member of a party organized to explore Tiburon island in the Gulf of California.

B. W. Vallat, formerly with the Colorado Fuel and Iron Company, is now connected with the Northwestern Iron Company at Mayville, Wisconsin.

Claude T. Rice, at one time on the staff of the JOURNAL, is editor and publisher of *Mines and Methods*, a new paper just started at Salt Lake City, Utah.

Bruce R. Warden, mining engineer for the Nicola Valley Coal and Coke Company, operating the Middlesboro colliery at Nicola Valley, B. C., has resigned.

E. P. Merrill, manager of the Real del Monte & Pachuca Company, has returned to Pachuca, Mexico, after a trip of several weeks to New York and Europe.

Stephen S. Goodale, a graduate of the Colorado School of Mines, has taken charge of the department of metallurgy and ore dressing in the School of Mines of the University of Pittsburg.

F. H. Banbury, engineer of the Acheson Oildag Company, of Niagara Falls, N. Y., sailed for Europe on Sept. 25. He will first go to Genoa, Italy, later visiting other countries to establish the Oildag process.

C. W. Saxman, formerly general manager of the Yampa Smelting Company and the Tintic Mining and Development Company, has opened an office at 312 Dooly building, Salt Lake City, as consulting mining engineer.

H. T. Dickinson, superintendent of mines for the De Beers Consolidated Mines, Ltd., at Kimberley, South Africa, is on a visit to the United States. His present address is at the Columbia University Club, New York.

Federico Stallforth, president of the Mexico Consolidated Mining and Smelting Company, has returned to the City of Mexico from a visit to the mines in company with J. B. Chavrier, a prominent French mining engineer.

President Taft, on his visit to Butte this week, was taken down to the 1200-ft. level of the Leonard mine. He is, so far as we know, the second President of the United States who has ever been underground. He also visited the smelting works.

Ole Hallingby, for a number of years assistant mechanical engineer for the Calumet & Hecla Mining Company, has been made superintendent of the La Salle and Laurium mines, succeeding F. W. Ridley, who was appointed superintendent of the Allouez and Centennial mines some time ago.

G. C. Bateman and H. Lawrence Brown, of Cobalt, Ont., have formed the firm of Bateman & Brown, and are prepared to undertake the management, examination and development of properties in the Cobalt district. Both members have had varied experience in Mexico, the United States and Canada. Mr. Bateman is engineer for the Temiskaming & Hudson Bay Company, and Mr. Brown for the Silver Cross, Belmont and others.

Obituary

Charles Hamilton Paine died in Boston, Aug. 23, aged 56 years. He was in business in Boston from an early age, and for over 20 years was a member of the banking house of Paine, Webber & Co., from which he retired a few years ago. He was interested in a number of mining companies, and was a director in several copper companies.

Hugh Fletcher, of the Geological Survey of Canada, died at Lower Cove, Cumberland county, N. S., Sept. 23, of pneumonia, aged 59 years. Mr. Fletcher, who had been connected with the survey for 37 years, was a noted authority on the mineral resources of Nova Scotia. He had been engaged during the past summer in mapping out the coal areas of Cumberland county. At the time of his seizure he was on a visit to James Baird, manager of the Fundy mine.

Walton Townsend died in New York, Sept. 25. He was one of the pioneers in 1849, making the trip to the Pacific coast by way of Cape Horn. Settling in San Francisco, he played a prominent part in the early history of that city. Later he went to Portland, Ore., where he organized a system of pack trains, running into what is now Idaho. He also founded a bank there, and became interested in mining, and is said to have supplied funds for the development of the Copper Queen mine, in Arizona. Returning to New York, he retained his interest in mining projects until age compelled his retirement.

Societies and Technical Schools

Massachusetts Institute of Technology—W. E. Wickenden has been appointed assistant professor of electrical engineering to assume the duties vacated by Prof. George C. Shaad, who has gone to the University of Kansas to take charge of the electrical department at that place. Mr. Wickenden is now in the electrical engineering staff of the University of Wisconsin and has made a record for himself in teaching and research.

University of Illinois—H. H. Stoek has been appointed professor of mining engineering in the new Mining School at the University of Illinois. Mr. Stoek was graduated from Lehigh University in 1887. He received the advanced degree of E. M. in 1888. In 1885 he was assistant in the Department of Mineralogy, National Museum, Washington; in 1887 he was inspector of dredging on the Thames river, Connecticut; in 1888 he was assistant engineer of the Susquehanna Coal Company, Wilkes-Barre, Pennsylvania; and for three years following 1900 he was instructor in mining, metallurgy and geology at Lehigh University; during this period also he served as an expert in examining iron properties in North Carolina and in inspecting copper and iron mines in Michigan and Minnesota; from 1893 to 1898 he was assistant professor of mining and metallurgy at the Pennsylvania State College; and in 1898 he became editor of *Mines and Minerals*, published at Scranton, Penn. He is the author of many technical papers.

Special Correspondence from Mining Centers

News of the Industry Reported by Special Representatives at Butte, Denver, Salt Lake City, Goldfield, Cobalt and Toronto

REVIEWS OF IMPORTANT EVENTS

San Francisco

Sept. 22—Those interested in mining in Mariposa think that the county is on the eve of a mining revival. A number of mines which have been idle for years are being reopened with good prospects. One which was abandoned some years ago and the machinery removed, has been started again by Los Angeles capital, and is now the largest producer in the county. The veins in the county are generally large ones, it being one of the five Mother Lode counties of the State. The grade of ore on the average is higher than that found in the other Mother Lode counties. More of the gold is saved on the plates at the mill. From a total of over 51,000 tons worked in a recent year the saving on the plates was $6.89 per ton, while in Amador county the saving on plates was $3.04, in Calaveras $2.86, and in Tuolumne, $3.30 per ton; all these are Mother Lode counties. In El Dorado it was $7.40 per ton. The concentrates treated in Mariposa county yielded $88.38 per ton in gold and silver as compared with $67.43 in Amador, $51.84 in Calaveras, $47.78 in El Dorado and $25.68 in Tuolumne county. The total average recovery per ton in gold and silver from both plates and concentrates in Mariposa was $8 per ton, while in Amador it was $4.76 in Calaveras $3.72, El Dorado $8.22, and Tuolumne $4.17 per ton. Amador, Calaveras and Tuolumne counties had a much larger tonnage, while El Dorado was credited with a smaller tonnage. But these averages of Mariposa county are for the treatment of over 51,000 tons of ore from all the quartz mines of the county combined, large and small. The total recovery of gold and silver in that year in Mariposa was $408,711. These averages show the possibilities of quartz mining in Mariposa county to be excellent. There are plenty of known mines still lying idle for want of capital, which seems odd when people are looking for good mines, and those working in the country are making a good record in average values of ore treated. When ore will "plate" alone nearly $7 per ton, without counting concentrates, and there is plenty of it, the ledges producing it ought not to be neglected very long.

There is also increased interest in Inyo county of late, lying as it does on the borders of Nevada where many prospectors have been at work in the past few years. In addition to its gold and silver, Inyo county is the largest producer of lead in California, and it has good copper mines as well, not many of which have been developed as yet. The county turns out also about $1,000,000 worth of borax a year. Recent railroad building in the county has made it possible to open districts heretofore inaccessible, so that in the future the base ores may be readily shipped to smelteries. Some few smelting plants are in operation in the county and more are planned. It is true that the copperfields of Greenwater did not turn out as well as at first predicted, but the first predictions were made by interested parties who were too sanguine. The salines of the county are very abundant and have been but in part developed. Soda and borax are being utilized, but there are other salines which will later be utilized. Meantime satisfactory progress is being made with gold, silver and lead properties, and much development work is in progress in different parts of the county.

There is more mining activity in Sierra and Plumas counties than has been the case for years. The discoveries at Alleghany and Forest, particularly in quartz, though to some extent in auriferous gravels also, which occurred within the past two years, attracted numerous prospectors and capitalists to that mountainous section which had been long neglected. Now the Western Pacific only has 75 miles of track to lay to be completed, and as it passes through Plumas county it will give a wonderful impetus to that whole mountain region both as to timber and mineral resources. The whole mineral belt of the two counties is being now pretty thoroughly prospected. Heretofore gravel has been most sought for, but now the search is principally for quartz lodes. The reason quartz mining has not been so popular is that capital was slow to assist the quartz miners, but now there is plenty of money available for anyone who can make a good showing. There is a large copperfield in Plumas county on which development work has been carried on for some years, but there has been no output as there were no means of transportation. With the completion of the railroad in a month or so, the miners will be able to ship the ores to smelteries and get the reward for their work and patience. The grade of the ore found is high, and these fields should be remunerative.

Another one of the higher mountain counties which now expects to attract attention is Modoc, in the northeastern part of the State. The Hoag mining district, near Fort Bidwell, has a number of active mines which have been developed during the past few years, but there has been no production because they had no mills to reduce the ore. Grading and building on a millsite is now under way and a custom mill is under construction. The camp is now about four years old and the miners have done a great deal of work without much reward so far. There are no railroad facilities in that section, so ores could not be shipped to outside reduction works. Now that a mill will soon be ready for work there is more confidence in the camp and some properties have been sold and on others leases have been taken. The ores are free-milling and considerable ore has been taken out awaiting a mill, which has now arrived.

Denver

Sept. 24—In the upper Clear Creek district, at Empire, on the Colorado & Southern, the Marshall-Russell tunnel is an enterprise worthy of notice. It is projected for 12,000 feet, and has already been driven 4000 feet, and it is stated that the company owns all the claims along its projected line. In its course, it will intersect a gold-bearing series of veins, and also a silver-bearing belt, both of whose early records of yield from surface workings give great promise for the future production from the tunnel. Among other well-known producers which will be intersected are the Neef, Gold Dirt and Tenth Legion. New York capital is said to be doing the work.

The continued strikes of high-grade ore in the lowest workings of many of the Cripple Creek district big mines has given rise to the name "Deeper Cripple Creek," and much speculation is rife as to the new territory to be made available when the Roosevelt drainage tunnel shall have tapped underground waters far below present workings.

Butte

Sept. 23—At a special meeting of stockholders of the British Butte Mining Company held last week it was decided to create a new class of stock to be known as bearer share warrants. The company was formerly capitalized at $5,000,000 with $1 par shares. Under the new plan the capitalization remains the same but there will now be only 4,500,000 shares of $1 each and there will be in addition 25,000 bearer share warrants of the value of $20 each. Stockholders will be allowed to

exchange at the rate of 20 of their old shares for one of the new bearer share warrants, and will be allowed one such exchange for every 200 shares now held by them. The new share warrants are issued for the purpose of enabling the company's stock to be listed on the Paris Bourse and the warrants will be printed both in English and French. It is understood that the real reason for the change is that there is little or no market for British Butte stock in this country or in England but that a market may be created in France.

New proxies for the annual meeting of stockholders of the Davis-Daly Copper Company, have been received in Butte. The new proxies are made out to F. A. Heinze, H. M. Raborg and W. C. Shaw, the former being directors and the latter assistant secretary of the company. The proxies specify that a majority of the proxy committee shall control and that they may vote on any resolution or proposition that may be submitted to a vote of the stockholders. The annual report of President Heinze has also been forwarded to stockholders. The report states that since the Davis-Daly took over the properties from the old Davis-Daly Estates Company, the shaft at the Colorado has been sunk 327 ft., of which 151 ft. is three compartments and 176 ft. four compartments, while another compartment has been added to the former two-compartment shaft by raising a distance of 1005 ft. Stations have been cut on the 300,- 1200,- 1400,- and 1500-ft. levels, each of an average of 30 ft. long and three compartments wide, except the 1400 station which is 90 ft. in length. A total of 2575 ft. of crosscuts, 1839 ft. of drifts, 634 ft. of raises and 160 ft. of winzes have been run. The new company has paid on account of the debts of the Davis-Daly Estates Company, $524,881; for property and equipment to June 30, $121,-756; and for development and general expenses, $254,926. Development from the Colorado shaft is stated to have disclosed three veins, one of which is 30 ft. wide and will assay at 3½ per cent. copper, 6 oz. silver and 50c. gold. The other two veins are 5 ft. wide. The shaft is stated to be down 60 ft. below the 1500-ft. level. Newman Erb and S. M. Jarvis, who recently resigned from directorships in the company on account of a disagreement with Heinze, have sent out a circular letter soliciting proxies for themselves and urging stockholders to vote for a conservative handling of the company's finances.

Considerable apprehension was felt in Butte over the outcome of the struggle waged between Butte Engineers' Union No. 83 and the Western Federation of Miners. A few days since, by a heavy vote, the engineers decided to withdraw from the Western Federation, alleging that, owing to the stand taken by the latter organization in asking for the repudiation of contracts which the Butte union had entered into with the mine owners, and owing to other questionable tactics, they found it impossible to get along in harmony with the Federation. The Butte Miners' Union, also affiliated with the Western Federation, in reply, came out with an ultimatum that no engineer not in good standing with their union would be permitted to work in or around the mines. A meeting of the seceding engineers was held in Butte last night for the purpose of organizing a new local union, and resulted in a riot. Members of the miners' union attempted to break up the new organization and several shots were fired and one man slightly wounded. In addition to the actual violence which attends the situation the Western Federation of Miners has instituted action in the local district court to enjoin the engineers' union from withdrawing from the national body and particularly to enjoin them from taking away and appropriating about a thousand dollars worth of furniture, stationery and other articles alleged to belong to the Western Federation. The situation is regarded as serious inasmuch as both sides are determined in their stand, and the ultimate outcome may possibly be the shutdown of all the mines in the district.

Later—The threatened strike of miners has been ended by the hoisting engineers returning to the Western Federation from which they had separated.

Salt Lake City

Sept. 17—The Utah Metal Mining Company was launched last week at a meeting of the stockholders of the Bingham Central Mining Company and the Bingham Standard Copper Company. Besides these two companies, the other properties in the consolidation are the Bingham Central Standard Mining Company and the Bingham Metal Company. The new company controls 3300 acres. The first work will be the construction of an 11,000-ft. tunnel which will be an underground highway between the Tooele and Bingham sides of the mountain. The property will be fitted out with electrical equipment. Power will be generated by the company's plant operated by water power. S. H. Treloar is manager.

During August, mining companies operating in Utah mined and marketed 10,500,-000 pounds of copper. In comparison with previous months this shows a falling off of 125,000 pounds. The decrease was probably due to the explosion of the reverberatory furnace at the Yampa smeltery and the changes in the Copperton mill of the Utah Copper Company.

During the week ending Sept. 10, the ore shipments from Tintic amounted to 7590 tons. Two new shippers were added to the list, the Bullock mine and Ridge Valley.

Goldfield

Sept. 27—The Red Top Cross on the 600-ft. level of the Clermont shaft of the Goldfield Consolidated has encountered the hanging wall of the Red Top vein after driving 450 ft. No drifting has been done on the vein and the value of the discovery is still unknown. An unexpected discovery of a large body of high-grade ore has been made on the 600-ft. level of the Mohawk shaft. Free gold is disseminated through the ore.

The Diamondfield Black Butte Mining Company is about to present a reorganization plan to the stockholders. The company owes about $18,000. The proposal is that, after the sale of the property under execution they will organize another company with the same capital as the present corporation, and that the owners of shares in the present company will be given a period of six months within which they may exchange their shares with a payment of 2c. per share and receive an equal number of shares in the new corporation. All shares not exchanged within six months will be lost.

The estimated production for the district for the week ending Sept. 19 was 6790 tons, having an estimated value of $238,175.

The production of Tonopah for the week was 5950 tons having an estimated value of $148,750,

Indianapolis

Sept. 25—The national executive board of the United Mine Workers of America, which consists of twenty-six members, including President Lewis and two other resident officials, convened in this city, Sept. 23, to discuss plans for aiding the 8000 striking coal miners in Nova Scotia. The organization has been furnishing the strikers with funds since they went out last July and will make every effort to sustain them in their fight. The striking miners are demanding increased pay and improved conditions of employment as well as the privilege of membership in any organization they choose. The operators are putting up a fight to compel the Canadian miners to separate from the United Mine Workers of America.

The new flameless explosive used in some of the mines in Pennsylvania will come up for consideration at this meeting of the executive board also.

Toronto

Sept. 24—Dr. Eugene Haanel, director of mines, announces that the first electric smelting plant in Canada, on a commercial scale will shortly be established in con-

nection with the iron and steel industries of the Lake Superior corporation at Sault Ste. Marie, Ont. The company is arranging for the construction of a number of furnaces similar to those successfully operated in Sweden. Another electric smelting enterprise is in contemplation for the treatment of the iron ores of the Ottawa district. A company headed by Louis Simpson of Ottawa, has secured a power site at Chats Falls on the Ottawa river, for generating electric energy and it is proposed to invest about $7,000,000 in an electric smelting plant. The success of these undertakings, Dr. Haanel predicts, will result in an extensive electrical smelting industry in Canada, many localities offering specially favorable opportunities owing to the proximity of large but hitherto unavailable iron orebodies to suitable water powers.

Cobalt

Sept. 24—The much larger amounts which the lots in the Gillies Limit brought in the last sale is due to the find on the Waldman property. When the limit was first thrown open, the public was somewhat suspicious, but the finds on the Waldman and other properties showed that there were very good possibilities. At the present time the Waldman is running the plant of the Provincial mine, and will get air from that source until the new owners take charge. The shaft is now down 50 ft., and there is good ore in the bottom.

Another recent find which has enhanced the value of the Gillies Limit lots and the surrounding properties was made on the Red Jacket, formerly known as the Morrison. The discovery was made on the 125-ft. level, and at one point where the vein was cut, it was 29 in. in width, carrying about 2000 oz. in silver. This find was made in the Keewatin formation. It was only a few months ago that engineers in this section considered that high-grade veins in the Keewatin would only be of very rare occurrence, but the development in the last few months has upset the theories. Since that time the Crown Reserve, Nipissing, O'Brien, Lawson, Buffalo, Waldman, Red Jacket and others have opened up veins of high-grade ore in this formation. These discoveries have been the means of opening up large areas that were hitherto considered unworthy of being prospected.

Dr. Milton Hersey is making an examination of some of the Gillies Limit lots for a Montreal corporation. Doctor Hersey was much impressed with the recent discoveries that are widening the silver-bearing areas around Cobalt, and he points out that these new finds are indications that thorough prospecting will find silver in many parts that are now considered barren. When the power companies have air and electricity ready for delivery many more properties will be opened up, as they will then be able to commence work without the necessity of installing expensive plants, and the cost will be cut down from 50 to 200 per cent. This power will probably be ready for delivery at the end of the year, although mining men are not placing very much reliance upon the statements of the officials of the power companies, as they have been misled so often.

On Lot 6 of the Gillies Limit, recently purchased by M. J. O'Brien, the continuation of the Red Jacket vein has been discovered on the surface. It has been trenched for some distance and shows silver. This lot was formerly purchased by C. L. Pratt, of Detroit, but was forfeited. Negotiations are under way for the purchase of the Young-O'Brien lot with some of the people interested in the Crown Reserve.

A surprise was created the other day when the Nipissing increased the dividend to 7½ per cent. for the quarter. On the capitalization this means a disbursement of $450,000. This has been done without any attempt to increase the shipments appreciably, and will leave the cash reserve, which is usually held at about one million, on the same basis as formerly.

Mexico

Sept. 21—The message of President Diaz to the opening of Congress on Sept. 16 recites in a definite manner the attitude of the government toward recent political movements in Mexico which have been attracting considerable attention abroad. The President says: "During recent months there has been perceptible a political movement preparatory to the election of federal officers which is to take place next year. It is certainly praiseworthy that the Mexican people show each time a greater interest in the exercise of its electoral right, as this is an earnest that in selecting its future officials it will perpetuate those conquests which the republic has made under those beneficent influences of peace. Unfortunately not all the manifestations of electoral propaganda have kept within the peaceful limits of the law, and initiated by agitators, prompted by their own personal interests, certain disorders have occurred, which the police have repressed with true moderation. The government, whose principal duty it is to preserve public order, will not permit that this be disturbed even though to accomplish the object, it may be necessary to employ energetic measures. Nevertheless, it is confidently expected that this necessity will not present itself because the citizens will know how to make use of their rights subject to the law."

In another part of the message reference is made to the increased railroad mileage during the past semester, amounting to 520 km. The total railroad mileage of the republic at the present time amounts to 19,321 km. under federal concessions, and 4840 km. are under state concessions. During the second semester of the fiscal year the number of mining titles passed was 2072. This compared with the corresponding period of last year shows a falling off of 36 per cent. Comparing the exports and imports of the two fiscal years the message points out that the imports show a falling off of 75,000,000 pesos, while the exports diminished only 11,000,000 pesos. In the past year there was exported 16,000,000 pesos of coin, which affects the real difference between the value of the exports and imports.

The local zinc-mining interests are concerned in the possibility of the effect of the Mexican ore upon the European market, as a large supply of zinc from Australia and other parts of the world, and the throwing on the market of the considerable Mexican output may result in lower prices abroad. This consideration has somewhat unsettled the plans for extensive operations in the shipping of zinc ore to Europe.

The Mexican congress is now in session, and it is expected that shortly the new mining law which passed the house of deputies at the last session will come up before the Senate for final confirmation. The law is now before a joint committee of both houses of Congress, and will probably be enacted substantially in the form in which it was approved by the lower house.

Local geologists are of the opinion that the reported oil found floating in the Gulf of Mexico recently is not due to any seepage from underwater oil formations, but rather to the oil which is floated in immense quantities into the sea from the Dos Docas well which was blown in on July 4, 1907, and which is still uncontrolled. This well is near Tampico.

London

Sept. 15—The 20th annual general meeting of the Institution of Mining Engineers is in session at Newcastle-Upon-Tyne. The meeting extends over three days, and visits will be paid to places of interest in the neighborhood, including the Harton Colliery and the Newbiggin Colliery, where a shaft is being sunk through sand by the drop-shaft method. A description of this work is given in a paper to be read at the meeting by E. M. Bainbridge, Jr., and Walter M. Redfern. Other papers to be presented are on "Firedamp Caps," and the "Detection of Firedamp in Mines by Means of Safety Lamps," by E. Bessell Whalley and W. M. Tweedie, on the "Equipment for the Study of Flamecaps and for Miscellaneous Experiments on Safety Lamps," by Professor G. R. Thompson, and on the method employed in stopping an extensive leak under high pressure in the tubing of the East pit, Murton Colliery, in 1907, by W. O. Wood.

Mining News from All Parts of the World

New Enterprises, Installations of New Machinery, Development of Mines and Transfers of Property Reported by Special Correspondents

THE CURRENT HISTORY OF MINING

Alabama

JEFFERSON COUNTY

A definite statement has been given out by George G. Crawford, president of the Tennessee Coal, Iron and Railroad Company, as to some of the future intentions of the corporation in this district. The company has completed the purchase of large tracts of land in the western part of Jefferson county, Ala., adjacent to the Ensley steel plant. A big reservoir with pumping stations, reservoirs, etc., to supply a larger and cheaper supply of water will be provided, by-product coke ovens will be constructed in large number and other improvements made. Plants to consume iron and steel will follow later. The plans include the building of a concrete dam on Village creek, 490 ft. long and 90 ft. high, which will form a reservoir with a capacity to store 2,500,000,000 gal. of water. Pumping engines with a capacity of 25,000,000 gal. per day will force the water through a 42-in. pipe-line 2¼ miles long, to the Ensley distributing reservoir. The company is also opening a new coal mine and will build 1000 coke ovens.

Alaska

Rainy Hollow—Burnem, Kennedy & Conway are sacking copper ore at Juneau for shipment to Tyee.

Chicagoff—The new Chilean mill is *en-route* from San Diego. With the 4-stamp mill about 12 tons of ore is being treated daily, and under the new installation 30 tons can be milled.

Mills—The mill at Chicagoff is about completed. The building will accommodate 10 stamps, but only half will be installed this season.

The Reynolds Alaska Devlopment Company—The company at Valdez is said to have $40,000 to pay creditors. If a settlement is made the company will expend a large sum on development work.

Wild Goose—The company is profitably operating three hydraulic elevators on Ophir creek, in the Council district.

Ketchikan—A peculiar condition prevails at present in the copper districts of Alaska, with only Ketchikan shipping ore at present where last year numerous mines were sending great quantities to the Sulzer, Ladysmith and Tacoma smelteries. There are today but two real producing properties, the Mount Andrew and the It. The mines on Prince William sound and other parts of southeastern Alaska are either closed or doing development work.

Porcupine—A recoverery of 270 oz. of gold as the result of a 20-hour run was recently made at the placer at Haines. E. E. Harvey is in charge.

Innoko—Prospectors are rushing into this new district from Fairbanks.

Arizona

COCHISE COUNTY

Boston-Courtland—A double-compartment shaft is being sunk on the 300-ft. drill hole on Geronimo claim at Courtland. W. C. Humphries, manager.

Calumet & Arizona—The Irish Mag shaft, 1250 ft. deep, is being equipped with a 250-h.p. hoist and retimbered. Ore is meanwhile being hoisted through the Oliver shaft.

GILA COUNTY

Cordova—The Sullivan shaft between the Miami and Inspiration ground is down 400 feet.

Superior and Globe—Plan of crosscutting at 500-ft. level has been changed and shaft will be sunk deeper. A compressor is being installed.

GRAHAM COUNTY

Arizona Copper Company, Ltd.—Capital of company is now £703,984, including common and preference stock. Total dividends to date £2,731,671. Company office, Edinburgh, Scotland; mine, Clifton.

Shannon—Ore has been found below the lowest level of the mine at Clifton and the prospect of an important extension of the orebody is good.

MOHAVE COUNTY

Bi-Metal—The London Venture Corporation is reported to be negotiating for this mine near Kingman.

California

AMADOR COUNTY

Bunker Hill—The directors have decided to increase the monthly dividends from 3c. to 4c. per share. The orebody is being entered on the 1750-ft. level and drifting on the 1950 level will begin soon.

Kennedy South Extension—The electric power hoist has been started and cleaning out the shaft is going on.

BUTTE COUNTY

Mammoth Channel—The machinery for the new pumping and air-compressing plant at Magalia is being installed.

CALAVERAS COUNTY

Reiner—The pay channel, near Angels, has been reached at 270 ft. The 20-stamp gravel mill is installed and an additional 20 stamps ordered. J. C. Benson, superintendent.

EL DORADO COUNTY

Richmond—The group, near Omo, has been bonded to W. G. French, of Los Gatos, and will be operated. There is a small mill.

Heald—The mine at Nashville, owned by J. C. Heald, is under bond.

FRESNO COUNTY

Judges Mining Company—The company, operating the Richter, near Ockenden, has started up the new cyanide plant.

MARIPOSA COUNTY

Number Five—C. T. La Torbeau, superintendent, is installing an electric hoist and is sinking on the orebody, near Hornitos.

NEVADA COUNTY

New York-Grass Valley—In the mine which has been closed for a year, A. P. Wilson, working by himself, has found the lost ledge about 70 ft. from the shaft on the 900-ft. level.

Native Son—J. H. Bishop has obtained an extension of his bond on the mine at Blue Tent and will continue the tunnel.

Delhi—In addition to the rediscovery of the McMurray shoot in the west vein, there has been found ore on the east vein in the lowest or No. 8 level. Mine, near Columbia Hill, Hamilton Eddie, superintendent.

Eureka—The mine has been sold by Robert Morrow to Messrs. McCreedie, Tilton and McDonald, of Oakland, who are arranging to reopen it. It is near the Idaho-Maryland, Grass Valley.

PLACER COUNTY

Hidden Treasure—At the property, Bullion, H. T. Power, superintendent, a slope has been sunk a mile and a half from the mouth of the tunnel, from the white-lead to the blue-lead channel, 45 feet.

PLUMAS COUNTY

New York—The mine at Greenville has been closed, pay shoots not having

been found during the bond. The Indian Valley is also closed.

Long Valley—Superintendent Henry Adams reports 38 men at work on Rush Creek and the 10-stamp mill running steadily.

SHASTA COUNTY

Whiskey Creek—The group, a mile from Stella, has been bonded to C. M. Clark, of Buffalo, and W. W. Rees, of Redding. A 5-stamp mill for testing purposes will be erected.

Delta Consolidated—This company has made its first shipment of ore, the 6 miles of narrow-gage railroad being completed.

SIERRA COUNTY

General Sherman—The mine at Alleghany has been bonded to E. J. Morgan, Nevada City, who will transfer the bond to the syndicate operating the Gold Canyon and other mines at Alleghany.

SISKIYOU COUNTY

Golden Wonder—The mine on Cherry creek, near Yreka, James Whitney, superintendent, is ready to resume. A new concentrator has been put in the mill.

Mount Vernon—The mine at Cherry creek, near Yreka, after lying idle some years, is about to resume.

TUOLUMNE COUNTY

Confidence—The mine is being unwatered by Guy Scott, of Soulsbyville, and Charles Fisher, of Oakland.

Gold Spring—New pumping and hoisting machinery has been supplied at Jamestown.

Colorado

BOULDER COUNTY

Primos—McFarlane & Co., Black Hawk, has the contract for a 50-ton plant to treat company and custom tungsten ores at Nederland. E. F. Lake, Cardinal, manager.

Lilly of the West—The mine near Jamestown has been purchased by a Boulder company.

Livingstone—Ore from the Mianza ore shoot runs from $5 to $15 per pound. It is tellurim ore. Mine at Sugar Loaf.

CLEAR CREEK AND GILPIN COUNTIES

Gold Collar—A 100-h.p. boiler is being added at the mine. Alfred Skeels, Central City, manager.

Kansas-Burroughs—These mines, in the Central City district, which it is stated have been intersected by the Newhouse tunnel, show big orebodies, and are to be developed by laterals. The Central tunnel is also said to be sending out as much ore as the Newhouse, and a goodly tonnage is also being delivered from the portals of the Lucania and Rockford tunnels.

Aztec Mines—The Mountain Electric company will furnish a 75-h.p. motor and a Rand 10-drill compressor has been ordered. Henry Eilmann, Central City, superintendent.

Martin—An eastern company will develop this mine at Apex. Fred Thompson, Central City, manager.

Dump—I. R. Ball, Central City, has bond, and will install machinery.

Mixsell Mill—McFarlane & Co., Black Hawk, has the contract for a 10-stamp mill at Idaho Springs, for Phillip Mixsell.

Colorado Blue Bell—This company, Idaho Springs, is figuring on machine drills.

Gold Quartz—A Nebraska company is interested and is figuring on a mill. Office, Alice, Colorado.

Kennedy—The erection of a concentrating plant of 50 tons is planned. David Kennedy, Georgetown, manager.

Virginia City—The property, near Georgetown, is under negotiations for $75,000.

Big Blue—This group on Saxon mountain is reported sold for $65,000. A compressor and tramway may be installed.

CHAFFEE COUNTY

Last Chance—The company will operate claims in Taylor gulch near Garfield. H. G. Green, Salida, manager.

CUSTER COUNTY

Bull-Domingo—Work has been resumed at Bassick.

Geyser Silver Mining Company—Extensive explorations at Silver Cliff are carried on at 1400 and 1850 levels. A 40-ton mill is being built. O. W. Murphy, manager.

LAKE COUNTY—LEADVILLE

Wolftone—A daily shipment of 350 tons of lead-sulphide ore to local smelter is maintained.

Highland Mary—Work has been resumed and shipments of 50 tons daily are being made. North and south drifting is being carried on.

Robert Emmet—The mine is in shape to ship 30 tons daily of zinc ore to Chicago.

Ontario—The mine at Twin Lakes is shipping three carloads monthly from the lower tunnel.

St. Louis Tunnel—The lessee, the Little Evelyn Company, has discovered a body of silicious gold ore south of the tunnel in Breece hill and is shipping.

MINERAL COUNTY

Blue Bell—Active work is being carried on by the company in Creede properties.

Creede United—Machinery is being installed to advance the Humphries tunnel work and mill being repaired to take care of anticipated ore. A. E. Humphries is in charge.

North Creede Mining Company—The company has been formed in Denver with $500,000 capital to carry on extensive work at Creede.

SAN JUAN DISTRICT

New Gold King Mines—Improvements on mill are nearly completed and development is under way. V. E. Kerr, Silverton, manager.

TELLER COUNTY—CRIPPLE CREEK

Delmonico—The experimental plant for the treatment of dump ore without crushing has proved a failure.

Pharmacist—The mine will reënter the shipping list taking ore from the S. N. Simmons lease.

Jenny Sample—Work will be resumed under new contracts to local leasers.

Modoc—A crosscut will be driven from 500-ft. level to Ocean View claim. F. H. Frankenberger, manager.

Jerry Johnson—During the year 6840 tons averaging $27.24 a ton were shipped and 2782 tons averaging $4.72 a ton treated at the mill.

United States Reduction and Refining Company—During the first six months of the year the net earnings were sufficient to provide for sinking fund contribution due for that period, pay the accrued interest on the company's bonded indebtedness, and yield a substantial surplus for the preferred stock.

Indiana

CLARK COUNTY

A fine prospect for a coal mine has been discovered in the slate bank of a ravine on the Sweet farm, two miles north of Henryville. Recent high waters have washed pieces of pure hard and soft coal out of the steep banks formed by slate and gravel; the pieces found range in weight up to a pound or more. Preparation is being made to develop the find.

VIGO COUNTY

The regular quarterly meeting of the Indiana Coal Operators' Association was held in Terre Haute, Sept. 16, and the members heard an address by State Mine Inspector Epperson on the enforcement of the mining laws. The operators reported increasing prosperity in the mining industry. The committee appointed to promote the establishment of a safety station in the Indiana field, where fire-fighting devices could be kept, reported progress and promised a definite report at the December meeting.

Idaho

BOISE COUNTY

Gold Hill—Consolidation with Iowa has been effected. Active work for resumption is under way at mines and mills at Quartzburg.

Columbia—The 50-ton mill is nearly completed. I. H. Friar, manager.

SHOSHONE COUNTY

Orofino—Plans for the construction of the 100-ton mill at Murray have been received and work of grading the foundation begun.

Bear Top—This mine adjoining Orofino has shipped a car of ore and a car of concentrates. Eight or ten cars are being shipped each month. The capacity of the mill will be increased.

Federal—Efforts to clear up and retimber the portion of No. 6 tunnel which caved in last week are being pushed. This is an exit for all ore from both the Mammoth and Standard mines.

Hercules—Since the destruction by fire of the mill, the mine has been closed. The high-grade ores will be shipped and the other grades will be dumped near the site of the old mill.

Monarch—The construction of a 300-ton ore bin is to be begun. The orebody continues to widen out and the capacity of the mill is being increased from 75 to 200 tons.

Montana Standard—Zinc ore has been shipped from Burke to Joplin for experimental treatment.

Kansas

CHEROKEE COUNTY

Childress & Co.—A five-lot lease on the Lou Dillon tract has been purchased. Construction on a mill is to begin soon.

Herald—Extensive drill work on the lease has disclosed one of the largest runs of zinc in the district. The discoveries show more than 100 ft. of zinc ore above the 300-ft. level.

Lucile—The new mill at Baxter Springs will be in operation in October.

Mission—Foundations are completed for the 400-ton mill south of Baxter Springs. An additional shaft is being sunk.

Lancaster—The property is one of the leading producers at Baxter Springs. Water is secured from a 900-ft. well. Edward Miller, manager.

Michigan

COPPER

Adventure—The vertical shaft to open the three lodes exposed in the drill cores is down 200 ft., and good progress is being made. A hoisting plant capable of taking care of all the exploration is in commission, and the railroad spur is nearing completion. The first lode will be encountered at 950 feet.

Oneca—The first drill hole is down 600 ft., and is nearing lode. No. 2 hole, 4000 ft. to the north of No. 1, is down 120 ft. Both these drills are to expose the Baltic lode.

Ojibway—Drifting from the 800-ft. level between shafts is progressing satisfactorily and is revealing a good showing. Sinking is going forward in both shafts toward the 250-ft. level, at which point it will be temporarily suspended and attention given to opening up ground to maintain rock shipment for a mill run which will be made early the coming year. No. 1 shaft is down 1100 ft., and No. 2, 1200 feet.

New Baltic—The drill on this tract is down 325 ft., and has passed through an amygdaloid foundation carrying small copper. The formation is 750 ft. vertically.

Copper Range—Diamond-drill operations have been discontinued at Sections 7 and 8. A complete cross-section of the tract has been made. Nothing has been given out regarding future developments.

Mass—This company is blocking out stoping ground at the 13th, 15th and 17th levels on the so-called new lode, and when enough has been done to keep one lead of the mill in operation, shipment from this source will begin.

Osceola—The No. 4 Kearsarge shaft is about to enter the producing list. It is down 1000 feet.

IRON

Breitung Hematite—The mine at Naguanee, which has been idle for four years, will be reopened.

Missouri

JOPLIN ZINC-LEAD DISTRICT

Nowata—The mine at Porto Rico produced 226,000 lb. zinc and 13,000 lb. lead in 6 shifts. This is the greatest production of any sheet-ground mine in the district. The mine is on the Luke and Ash ground. Wilbur Squires, Joplin, manager.

Nashville-Tennessee—The company has nearly completed its 150-ton mill, East Hollow, northwest of Joplin. Edward Mallet, manager.

Zincite—The camp is becoming active. Two new mills on the Claycomb land have added to the production.

Thornton—The company has struck lead at 175 ft. on the Murphy-Hancock lease. Claude Thornton, manager.

Old Dominion—On the old I Know lease, at 135 ft., a large face of ore assaying 30 per cent. has been exposed and $2500 worth of ore taken out the first week. Walter Porter, manager.

Montana

BROADWATER COUNTY

Three Forks—The property, 6 miles north of Three Forks, is being developed by Herbert G. Dunbar. The work has been done on the Pennsylvania claim, where a shaft has been sunk 250 ft., which will be continued to the 300-ft. level.

BUTTE DISTRICT

North Butte Extension Development Company—At the annual meeting, Oct. 19, plans to raise money for development will be submitted. The company has paid for the Overman claim.

Davis-Daly—Newman Erb and S. M. Jarvis have secured an order of court resulting in postponing the annual meeting to Oct. 15.

CHOUTEAU COUNTY

Little Rockies—Stockholders have authorized sale for $300,000.

GRANITE COUNTY

Bi-Metallic—The south end of the mill on the property is being remodeled into a chlorination leaching plant for the treatment of tailings from the pan-amalgamation mills.

JEFFERSON COUNTY

Minneapolis-Corbin—The double-compartment shaft is now down 170 ft. At 200 ft. a station and crosscut will be made.

Nevada

CHURCHILL COUNTY

Nevada Hills Mining Company—The caving of the ground in a winze from the 350-ft. level disclosed a rich body of ore. The mine is at Fairview.

Nevada Hills—A strike of lead-silver-gold ore has been made in a faulted vein barren in the upper levels. W. H. Webber, manager.

ESMERALDA COUNTY—GOLDFIELD

Goldfield-Daisy—Spenker & Piper, leasing on the 200-ft. level of Daisy No. 2 shaft, have encountered a body of ore running from $18 to $25 per ton.

Goldfield Consolidated—A cave-in in Consolidated Hampton stope has put the Combination mill out of commission and will decrease earnings about $60,000 monthly until new mill is enlarged.

NYE COUNTY

Johnnie Mining and Milling Company—The company has purchased for $6000 the Battery group of five claims adjoining the Johnnie on the north. The Johnnie is at present working a force of 50 men. The Lane mill will be installed at once.

Pioneer Lease—Under the direction of W. B. Deveraux, at Pioneer, a crosscut from the 210-ft. level has cut the vein. The ore shoot was lost in the levels above and the present discovery is of importance.

Montana-Tonopah—Annual report shows debt of $300,000 paid and $45,000 in hand. Charles E. Knox, reëlected president.

STOREY COUNTY

Utah—Work is resumed and tunnel No. 4, abandoned 30 years ago, is to be extended.

Consolidated Virginia—Two crosscuts have been started on 1850 level.

Equitable—The mine in Six Mile cañon

is being sampled preparatory to resumption of development to 1200 ft. by the reorganized company.

Lady Bryan—Mill in Six Mile cañon is being remodeled to treat ore from 270-ft. stope.

WHITE PINE COUNTY

Cumberland-Ely—There is no change in the labor-strike situation and no ore has been produced for several months.

Steptoe Mill—The Nevada Consolidated is supplying about 6000 tons daily. No ore is coming from the Cumberland-Ely.

South Dakota

BLACK HILLS DISTRICT

Gold Dollar—The company has bought the Eleventh Hour mill and will move it to Squaw creek.

Golden Reward—Work will be resumed at Hardscrabble property.

American Eagle—A new ore shoot has been opened up. Company planning to start mill at Maitland again.

Utah

BEAVER COUNTY

Red Warrior—The control has passed back to the promoters. Development is planned. W. J. Merritt, Beaver, manager.

Revenue Consolidated—Development is going ahead. Roads have been completed to Newhouse and the compressor started. Crosscut tunnel to connect with the ore in the shaft is under way. A. J. Walter, Beaver, director.

JUAB COUNTY

Centennial-Eureka—Arrangements have been completed for the driving of a tunnel from the road west of Eureka to the 550-ft. level of the Centennial-Eureka. The tunnel will be 3000 ft. long and double tracked throughout and with electric haulage. The tunnel will save the company $15,000 a year in hoisting.

Lower Mammoth—The company will complete retimbering and sinking of the shaft by Dec. 1. With the completion the mine will again be one of the Tintic producers.

SALT LAKE COUNTY

Utah Copper Company—The August output was 5,162,716 lb., and cost slightly over 8c. About 8500 tons daily are being treated at Copperton and Garfield. "Stripping" is not made a charge against operating expenses in the above cost estimate.

SUMMIT COUNTY

Uintah-Treasure Hill—A night shift of ten men has been put on at Park City on the 600-ft. level.

Silver King Coalition—The ventilation hole drilled between the Hanauer and the Alliance tunnel of the Silver King will be finished soon.

Washington

KITTITAS COUNTY

Gallagher—The property at Cle Elum has been sold by the receiver to L. A. Johnson. Work will he resumed. G. W. Gallagher, manager.

OKANOGAN COUNTY

Q. S. Mining Company—The annual meeting decided to erect a customs smeltery near the mines. A. M. Dewey, Spokane, manager.

Wisconsin

ZINC-LEAD DISTRICT

Fox—The mine at Benton was bought by Mineral Point Zinc Company for $25,000. The fee to the land, 259 acres, was bought for $32,500. It has two shafts to ore, and is equipped with 75-ton mill.

Wisconsin Zinc Company—The company has taken possession of the property of the LaFayette Land and Mining Company, 1900 acres between Shullsburg and Benton.

Vinegar Hill—A new shaft was started on the Rundell farm at Rewey.

Wyoming

CARBON COUNTY

Leighton-Wyoming—Machinery from the Haskins mine will be moved to property near Dillon. J. T. Leighton, manager.

Walcott—Development is under way and equipment installation completed at Elkhart mine, Saratoga. W. C. Sammons manager.

Ferris-Haggerty—Engineers are examining mine and holdings of old Penn-Wyoming company in connection with pending negotiations.

Canada

ONTARIO—COBALT

Trethewey—Another 10 per cent. dividend will be declared in the near future.

Hylands—A new vein, in width up to 28 in., carrying silver, has been discovered.

McKinley-Darragh—During August the mine produced 140,000 oz. silver. At the present the mill is unable to handle the ore on hand.

Bailey—A tunnel will be started to cut the vein from which the Cobalt Central mined.

White Reserve—The property, in the Maple Mountain district, has shut down temporarily. It is in good condition, and a shipment of 6½ tons was recently made. Internal dissension is probably responsible.

Nancy Helen—A 20-ton shipment has been made.

Kerr Lake—The mine is producing 200,000 oz. of silver per month at an estimated cost of about 7½c. per oz. All of this output is from development.

La Rose—This company has declared the quarterly dividend of 3 per cent. with 1 per cent. bonus. The Lawson will soon ship ore steadily, and this will add to the resources of La Rose.

Ore Shipments—Shipments from Cobalt for the week ending Sept. 18 were as follows: Crown Reserve, 63,000 pounds; Drummond, 72,100; Kerr Lake, 160,050; La Rose, 130,000; Nipissing, 252,301; O'Brien, 63,960; Temiskaming, 60,000; Trethewey, 123,000; total, 924,420 pounds.

ONTARIO—GOWGANDA

Prospectors Exploration and Development Company—Ten claims have been staked on Meteor river, a new district, 16 miles southeast of Gowganda. The formation is diabase broken by numerous calcite veins.

Bartlett—Crosscutting at the 100-ft. level has resulted in the discovery of new veins. On shaft No. 2 a vein found in the shaft at 40 ft. is now yielding at 70 ft. Several new veins have been recently uncovered on the surface.

ONTARIO—PORT ARTHUR

Glenorchy—The company is prospecting quartz veins and iron formation on Canadian Northern railway at Glenorchy.

ONTARIO

Minnehaha—Active operations have been commenced at Manitou lake, by the Minnehaha Mining and Smelting Company, of Buffalo.

Wright—The shaft is down 30 ft., at which depth the ore encountered shows gold. The mine is at Dryden.

BRITISH COLUMBIA—ROSSLAND

Le Roi—The main shaft will be sunk below the 1650-ft. level and diamond drilling undertaken when pending financial arrangements are concluded.

Westmoreland Copper—An option on this property in Westmoreland county has been given to L. Vogelstein & Co., of New York, and an engineer has been sent to examine the property.

YUKON TERRITORY

Dawson—The largest nugget in the Forty-Mile district was found a few weeks ago by Carlson & Wagoner on No. 7. It weighs 65 ounces.

Gold Scuppers Dredge—Arrivals from the Forty-Mile district bring word that the dredge, the uppermost on Walker's Fork, has had excellent pay all summer.

Lone Star—The mill started last month, indicating renewed activity.

Klondike—Great prosperity is reported at the quartz properties; 110 quartz claims were located in July, and over 150 applications were made in August. A stampede is reported from the lower Yukon to the month of the Kuskokwim river.

Mexico

AGUASCALIENTES

Asientos—The Aguascalientes Metal Company, Albert Doerr, manager, is making heavy shipments.

Los Angeles—Bruno Newman is developing extensively on this and El Doctor.

CHIHUAHUA

Dolores Mines Company—A dividend of 18 per cent. has been declared. The profits for three months to Aug. 31 were $141,358. Total cash resources, $308,819. The mine is in western Chihuahua.

Palmilla Mill—The milling company has approved plans by Bernard MacDonald for a 60-stamp unit of the proposed 200-stamp installation. The mill will be south of Palmilla mine and treat also custom ore. Water for mill will be supplied by hydraulic ram from flow from new Palmilla tunnel.

New Year Mining Company—At Sierra Mojina, west of Gallegos, the company is developing the Sierra Mojina, an old silver-lead-gold mine.

Naica—The Naica, Lepanto and Ramon Corona mines are shipping steadily a large tonnage of silver-lead ore, most of which is treated at the Encinillas smelter at Santa Rosalia.

Las Plomosas—Jose Lago is completing his concentrating plant near the Conchas river, and expects to produce 30 tons daily of high-grade zinc concentrates.

San Carlos—The company is developing some enormous ledges of ores carrying gold, silver, lead, copper, zinc and iron in western Chihuahua, near the Rio Grande.

DURANGO

Ventanas—The 200-ton plant and hydroelectric installation is nearly completed. The mine is now owned by an English company. D. J. Pullinger, manager.

Guadalupe—The mine at Indé is operating regularly. It receives power from the Sestine river for 100-ton mill. A. A. May is manager for the Barings of London, owners.

El Toro—A Chicago company is operating this property and another at San Ramon in the Topia district, near Canales.

Avino—Under new management this English owned mine near Durango is planning to operate, shipping product to smeltery.

Velardeña—The smeltery is buying custom ore. One copper and three lead furnaces are in blast.

Mapimi—A geological survey of the Peñoles company's property is being made.

GUANAJUATO

Nueva Luz—The shaft to cut the Veta Madre at 2000 ft. is now down 1366 ft. Carl Henrich, manager.

San Cayetano—The successful unwatering of mine by the tunnel has been accomplished.

Guanajuato Consolidated—Estimated gross value of 7433 tons of ore for August, 128,000 pesos. Profit, 56,000 pesos; 8300 pesos was spent on development.

GUERRERO

Maine and Nebraska—The smeltery near Balsas is completed. Walter E. Koch, engineer.

La Union—The copper property near the coast is being explored.

La Dicha—The property of the Mitchell Mining Company is still closed awaiting adjustment of the company's affairs.

JALISCO

San Pedro Analco—A cyanide plant will be erected soon. Patio process is now used. Carlos Gil, manager.

Cinco Minas—Road to Tequila has been repaired and much machinery is being taken to mine. Sinking on vein is being pushed. H. E. Crawford, manager.

Mina Grande—This mine, Hostotipaquillo district, has been sold to a French company in which F. J. Fournier is interested. Luis Chevrillon is engineer.

Mololoa—A Toronto company is developing and will erect a plant.

Amparo—The mine at Etzatlan is being extensively developed and good results are obtained in the mill.

Agua Blanca—Pumps and hoist will be installed and mill overhauled. The property, in Autlan district, now belongs to Jalisco-Guanajuato Development Company, Dwight Furness, manager.

HIDALGO

Flojonales—The Robert S. Towne interests have purchased this mine at a town of same name in northern part of State, and will operate. Explorations have been carried on for two years.

MICHOACAN

Santiago—Plans for a 1000-ton mill are being made. The mine yields low-grade gold ore. It is controlled by a Chicago company.

NUEVO LEON

Cruz del Aire—An aërial tramway is under contract. The company at Sabinas Hidalgo is shipping 30 cars monthly.

OAXACA

Fresno-Belvoir—The H. W. Caltin interest has been sold to H. M. Smith and D. B. Meyer, who will exploit the mine at Taviche.

Santa Sofia—This mine, near Santa Catarina, is taking out gold ore of high grade.

Guebeshe—Railroad from Ocotlan to mill is nearly completed.

Treadwell—Drifting has been started at the 400-ft. level. W. N. Brown, manager.

Victoria-Tapada—A cyanide mill is being installed at Totolapam. J. W. Brill, manager.

Rio Seco—A mill is being installed on this property in the Nochistlan district.

QUERETARO

Republican Mining and Milling Company—The company is extensively mining antimony at Maguey Verde, near Estorax. The ore is treated at Wadley, San Luis Potosi, and the product shipped to England.

SAN LUIS POTOSI

Benito Juarez—The 300-ton cyanide plant is completed. Mine is at Salinas. J. C. Brennon, manager.

SINALOA

Choix Consolidated—The company is operating in El Fuerte district.

Piramide—The company is developing successfully in San Jose de Gracia district.

SONORA

El Temblor—The mine near El Tigre has been sold to J. J. Steindler, of New York for $50,000.

Calumet & Sonora—Mill of Joplin type, 110 tons daily capacity, is being erected at Cananea to treat mine's lead-zinc and lead-copper ores.

Promontorio—The 10-stamp concentrating plant, near Alamos, installed by the Clark Copper Company is completed.

Greene Cananea—New York office repudiates report of early dividend. Company in August produced 3,784,000 lb. copper; 70,312 oz. silver; 421 oz. gold.

TEPIC

El Dorado—A smelter has been purchased to be installed at Amatlan de Cañas. Capacity, 15 tons.

ZACATECAS

National Smelting—Operations are resumed at Chalchihuites.

Noria—A strike of 8-kilo silver ore has been made at 105 meters in depth. The mine is at Sombrerete.

Africa

WEST AFRICA

Gold production of Ashanti and the Gold Coast is reported at 17,766 oz. in August. For the eight months ended Aug. 31 the output was 199,401 oz. bullion in 1908, and 166,438 oz. in 1909; a decrease of 32,963 oz. The bullion reported this year was equal to $3,268,955, or 158,150 oz. fine gold.

South America

PERU

Inca Mining Company—A 100-stamp mill will be installed at Santo Domingo mine, Carabaya. C. W. Brown, manager.

Montebello—Extensive exploration is being carried on at Carabaya.

Metal, Mineral, Coal and Stock Markets

Current Prices, Market Conditions and Commercial Statistics of the Metals, Minerals and Mining Stocks

QUOTATIONS FROM IMPORTANT CENTERS

Coal Trade Review

New York, Sept. 29—The coal market in the West shows no change from the preceding week. A little more activity in Lake shipments is reported, but not much. Production is increasing slightly, but an effort is being made, apparently, to regulate it by demand.

The Eastern bituminous trade is improving, but prices continue very low, and there is no prospect of an advance as long as the West Virginia competition continues.

The anthracite trade is steady and follows its usual course with little or no variation.

The Anthracite Coal Trust Suit—The taking of testimony in the Government suit against the alleged anthracite coal trust was resumed in Philadelphia, Sept. 27. President Baer, of the Reading company, was the first witness, and he denied the existence of any trust or agreement to maintain prices or regulate production.

COAL TRAFFIC NOTES

Coal and coke tonnages originating on Pennsylvania railroad lines east of Pittsburg and Erie, year from Jan. 1 to Sept. 18, short tons:

	1908.	1909.	Changes.
Anthracite.....	3,620,482	3,414,412	D. 206,070
Bituminous.....	23,424,136	25,873,455	I. 2,449,319
Coke.....	4,895,229	7,563,228	I. 2,667,999
Total.....	31,939,847	36,851,095	I. 4,911,248

The total increase this year to date was 15.4 per cent.

Coal tonnage reported by the Southwestern Interstate Coal Operators' Association for the month of June, short tons:

	1908.	1909.	Changes.
Missouri.....	142,593	162,921	I. 20.328
Kansas.....	279,752	430,584	I. 150,832
Arkansas.....	113,051	142,587	I. 29,536
Oklahoma.....	128,466	186,123	I. 57,657
Total.....	663,862	922,215	I. 258,353

The total increase in tonnage this year was 38.9 per cent.

New York

Sept. 29—The market is steady and quiet, business being slow this week. For prepared sizes schedule prices are $4.75 for lump, $5 for egg, stove and chestnut, f.o.b. New York harbor points. For steam sizes quotations are as follows: Pea, $3.15@3.25; buckwheat, $2.35@2.50; No. 2 buckwheat or rice, $1.70@2; barley, $1.35@1.50; all f.o.b. New York harbor.

BITUMINOUS

Conditions are unchanged. Deliveries are improving, but new business is rather held back by the celebration in New York this week. Orders from the Far East and the Sound continue to come in, but New York harbor is slower. Transportation is a little irregular, freight trains being held up by the extra excursion trains which most of the roads are running. Prices are unchanged.

In the coastwise freight market vessels are in good supply, and rates are unchanged. New York harbor quotes on small vessels 50c. around the Cape, with 5 to 15c. higher to special points. Philadelphia quotes on large vessels 60@65c. to Boston, Salem and Portland, 65@70c. to Portsmouth, 70@75c. to Lynn, and 75@80c. to Newburyport.

Birmingham

Sept. 27—The demand for coal is increasing, and more mines are in operation than for two years past. The railroads are beginning to feel a sharp demand for cars, but no shortage is reported yet. All the coke ovens available are being put in operation to meet the demand from the furnaces.

Chicago

Sept. 27—The coal market continues strong for everything except fine sizes from Illinois and Indiana mines. Domestic coals are in steadily increasing demand. Prices hold firm; on western lump they are advancing slowly.

Illinois and Indiana sell, in car-lots, at $1.75@2.65 for lump, $1.60@1.75 for run-of-mine and $1.20@1.40 for screenings. Smokeless brings $3.55 for lump and $3 for run-of-mine, with occasional cuts of 10 or 15c. on forced sales to escape demurrage. Hocking is in good demand at $3.05. Gas coals are steady with no change in price. Anthracite shows no important change.

Cleveland

Sept. 27—Lake shipments are improving, but are still light for the season. The local market for steam coal is strong and active; domestic coal is also doing well. Prices are unchanged.

Indianapolis

Sept. 27—While there are a few unsatisfactory conditions in coal mining, there is an evident and gradual increase in the output. Railroad officials report a heavy demand for cars and have instructed their agents and yard masters to look sharply after the car movement.

The 200 men employed in Deering Mine No. 8, near Clinton, who went on a strike because they deemed the cage unsafe, returned to work after remaining out two days. Secretary Penna, of the Operators' Association, insisted that the men return to work, holding that the stopping of work was a violation of the wage contract.

Pittsburg

Sept. 28—Lake shipments have improved but are not extremely heavy. The local demand shows continued improvement, with prices hardening and the prospect of a definite advance in the near future. The regular market remains quotable at $1.10 to large consumers and $1.20 to retail dealers, for mine-run at mine, with slack at 65 cents.

Connellsville Coke—The market continues excited, and prices have advanced sharply. Even odd lots for immediate shipment cannot be picked up at less than about $2.75 for furnace, while the outside range is indicated by one sale made in the past few days, covering several thousand tons per month over the fourth quarter, at $3, so that the market for prompt and near-by has advanced about 25c. in a week while the advance in prompt coke from the low point last May is well in excess of $1.25. Less than a week ago a sale of 15,000 tons a month over the entire year 1910 was made at $2.90, and since then three or four sales have been made at the same price, one over the whole year and the others over the first six months. These transactions followed ineffective bids of a number of furnaces at $2.75 for next year, and the position now is that there are very few sellers at $2.90, the majority holding their coke for $3 or higher, and there seems to be no doubt that some such level will be established, the market scoring a really astonishing advance.

We quote standard furnace coke at $2.75@3 for prompt and fourth-quarter delivery, and $2.90@3 for next year, with foundry coke $2.75@3 for this year and $3@3.25 for next year.

The *Courier* reports the production in the region in the week ended Sept. 18 at 426,648 tons, and shipments at 4949 cars to Pittsburg, 7510 cars to points west of Pittsburg and 891 cars to points east of Connellsville; a total of 13,350 cars.

St. Louis

Sept. 27—Coal men are in better humor than for several years. Prices have had an upward trend all week and continue to advance. All southern Illinois operators are at present so crowded with business that they are not taking any orders and guaranteeing shipment under 30 days. The lower-grade mines are benefiting by this condition.

Staunton, Mt. Olive and Springfield district coals are bringing $1.25@1.35 at mine, or $1.72@1.82, St. Louis, for 6-in. lump; 3-in. lump is being offered at 5 or 10c. less. Nut coal is 90c. per ton at mine, or $1.42, St. Louis. These prices are quoted for immediate shipment only and it is intimated that the price will be raised probably as high as $1.50 per ton at mine about Oct. 1. Standard 6-in. lump is $1@1.10 at mine, or $1.52@1.62, St. Louis; 2-in. lump is offered for 10c. a ton less. Screenings and fine coal are away off. Standard screenings have been offered at 15@20c. at mine and are on the market in an abundance at that figure. Steam nut is offered freely at 50c. at mine, or $1 f.o.b., St. Louis. Carterville lump and egg are now strong at $1.50 at mine and $2.17, St. Louis. The demand for washed No. 1 is strong and for No. 2 fair.

Iron Trade Review

New York, Sept. 29—The iron and steel trades have been characterized this week by a continuance of the active buying of material, though there has been rather less excitement than was manifested in the preceding week.

Pig iron has sold actively in the Central West, where bessemer and basic have been the varieties chiefly in demand. In the East foundry iron has been the leader, basic pig being less active. Prices remain firm, with an advancing tendency.

In finished material structural steel is called for by many new contracts, generally of moderate size. Plates and bars are also active, and the demand for rails and other general building material is good everywhere. Mills are generally full, and prompt deliveries are no longer easy to obtain.

The railroads continue to be buyers of bridge and other material, while orders for rails are coming in freely for 1910 delivery. There is also a good demand for light rails for industrial and mining work.

Rates on Steel Products—The carload rates on steel rails from Johnstown, Penn., and Cumberland, Md., to Pacific Coast points have been reduced from $14 to $13.70 per ton; and a rate of $13.10 has been made from Lorain, Ohio, to the same points. Car wheels and axles have been given a rate of 77c. per 100 lb. from the Pittsburg district to Pacific coast points.

Baltimore

Sept. 28—Exports for the week included 1,547,114 lb. structural steel and 629,501 lb. miscellaneous iron and steel to Panama; 3,174,260 lb. steel billets to Liverpool; 740,712 lb. tin scrap to Rotterdam. Imports included 635 tons ferromanganese from Liverpool; 5488 tons cupreous pyrites from Spain; 11,230 tons iron ore from Cuba.

Birmingham

Sept. 27—A good demand, a steady inquiry and an advancing price are conditions that prevail with the Southern pig-iron market. Save with regular customers there is but little iron to be obtained for delivery during the balance of this year. There are five or six furnaces scheduled to go into blast during the month of October. The quotations are now being made at $15 per ton, No. 2 foundry; two or three companies have already announced that figure and have notified agents, the price to be maintained whether for immediate delivery or into the first half of the coming year. The minimum price has settled on $14.50 per ton.

Chicago

Sept. 28—Strength continues in practically every branch of the iron market, with advancing prices. Pig iron sells in good-sized lots; $14.50@15, Birmingham ($18.85@19.35, Chicago) obtains on sales of Southern No. 2. Northern iron holds to $18.50@19, with some sales made at $19.50. Lake Superior charcoal iron is in good demand at $19.50@20. The ordinary sale continues to be 300 to 1000 tons, with an occasional larger sale.

Sales of iron and steel materials continue large. Coke is active at $4.85 for the best Connellsville.

Cleveland

Sept. 28—Sales of small lots still continue. The docks at all the Lake Erie ports are crowded, and there will be trouble about storing ore.

Pig Iron—The market is active and prices are advancing. Heavy sales have have been made of all kinds except basic. Current quotations are: Bessemer, $18.40 @18.90; basic, $18@18.50; No. 2 foundry, $17.75; gray forge, $16.25@16.50, Cleveland delivery.

Finished Material—Several large contracts for shapes and plates are pending. All lines are active. Store trade in bars and structural shapes is heavy, and nails are in demand.

Philadelphia

Sept. 29—Extraordinary quantities of iron ore are arriving at this port from foreign sources of supplies and contracts are being placed for additional large winter deliveries. The Pennsylvania Steel and the Bethlehem Steel companies are increasing their imports and additional unloading facilities are being provided at Port Richmond. Furnace companies are contemplating large ore supplies far in advance. All kinds of pig iron are strong, but the market does not show as much business as the week before. The advancing tendency in all kinds of pig is reflected here, but no advances have been made. Basic will move upward first and will probably be followed by No. 2 X foundry. Gray forge is quiet. No. 2 X foundry is $18.50; gray forge $17.50 and basic $18@18.50 per ton.

Steel Billets—Buyers are calling for deliveries according to contract. Billets have been quoted 50c. higher on recent inquiries.

Bars—Today's reports show still further activity in both common and refined iron, especially for delivery in 30 to 60 days. Stocks of iron in country stores have been almost depleted.

Structural Material—An important demand this week is from railroad companies who have decided upon increasing station and terminal facilities. Local construction demands are taking a good deal of material.

Scrap—Nearly all kinds of scrap iron have moved up a little in price and dealers are on the warpath for heavy melting steel, railroad and yard scrap. The market is very strong and stocks of desirable scrap are light.

Pittsburg

Sept. 28—Developments in iron and steel prices have shifted largely from pig iron to finished products. Effective today the American Sheet and Tin Plate Company has advanced flat sheets $2 a ton to 2.30c. for black and 3.35c. for galvanized, 28 gage, leaving corrugated roofing unchanged at $1.55 per square for painted and $2.80 per square for galvanized, and has advanced tinplate 10c. per box to $3.50 for 100-lb. cokes. One of the independents had made a sharp advance in its prices last month, while last Friday the Youngstown Sheet and Tube Company advanced its prices $2 a ton on black sheets and $1 a ton on galvanized.

Bars, plates and shapes show a much stronger tone, although the absolute minimum of the market cannot be quoted higher than 1.40c. on bars and 1.50c. on plates and shapes. These prices cannot be done for next year's delivery, and we can report sales of good-sized tonnages of steel bars for first quarter at 1.50c and of plates at 1.60c., the market standing at this range, depending on tonnage and delivery, with a clear prospect that minimum prices will soon be 1.50c. on bars and 1.60c. on plates and shapes.

Spang, Chalfant & Co. have just secured

a contract for 30 miles of 16-in. line pipe for a western gas interest, and have also secured the Fort Worth, Tex., contract, covering 100 to 110 miles of pipe of various sizes.

Pig Iron—A sale not hitherto reported was 5000 tons of bessemer from the Bessemer Pig Iron Association to the Republic Iron and Steel Company for fourth-quarter delivery at $17.50, Valley. Since then the Youngstown Sheet and Tube Company has bought 25,000 tons from the association, for delivery over the first half of next year, at $18, Valley furnace. There have been some small lots sold for fourth quarter and first quarter at $18, Valley, and the market is firm at this figure. Basic may be quoted nominally at 25c. advance for this year, at $16.25, Valley. A large local consumer has bought 12,000 tons, paying for foundry $16.50, Valley, for fourth quarter and $17 for first quarter; for forge, about 75c. less. The minimum of the market is quotable on this basis, but furnaces ask 25 to 75c. higher.

Ferromanganese—The market continues strong, and prices are firm at $42.50@43 for prompt, $44 for fourth quarter and $45 for next year, all at Baltimore.

St. Louis

Sept. 27—Alabama pig iron is quoted the same as last week, at $14 per ton, Birmingham, or $17.75 f.o.b., St. Louis. Nearly all of the producers are entirely sold up for the rest of this year. The future market is active and producers are not willing to tie up any business for delivery after the first of the year at present prices. Foundries are now running full time and find a very good demand for finished products.

Metal Markets

New York, Sept. 29—The markets generally show only slight changes from last week; the tendency in most cases is inclined to be strong, on account of increased consumption.

Gold, Silver and Platinum

UNITED STATES GOLD AND SILVER MOVEMENT

Metal.	Exports.	Imports.	Excess.
Gold:			
July 1909..	$16,661,782	$ 3,269,885	Exp. $13,391,897
" 1908..	4,845,272	2,949,179	Exp. 1,896,093
Year 1909..	80,496,119	23,405,477	Exp. 57,090,642
" 1908..	58,363,098	29,357,075	Exp. 29,006,172
Silver:			
July 1909..	5,049,366	3,926,117	Exp. 1,123,249
" 1908..	4,930,746	3,039,581	" 1,891,165
Year 1909..	34,409,032	26,798,145	" 7,610,887
" 1908..	30,445,291	24,180,929	" 6,264,362

Exports from the port of New York, week ended Sept. 25: Gold, $10,000; silver, $956,285, to London and Paris. Imports: Gold, $61,609; silver, $158,978, from Central and South America.

Gold—The price of gold on the open market in London was a little higher, 77s. 9⅝d. per oz. being obtained for bars and 76s. 4⅝d. per oz. for American coin. A large part of the supplies arriving was taken for Russian account. Exports from New York were $1,400,000 to Canada.

Platinum—Demand is active, especially in the jewelry trade. There has been a further advance of 50c., and dealers are now asking $26 per oz. for refined platinum and $29.75 for hard metal, while $21@22 per oz. is paid for good scrap.

Our St. Petersburg correspondent writes, under date of Sept. 16 that prices are without change. The general conviction is that a further increase is to be expected. The agreement between the Société Anonyme de l'Industrie du Platine and the estate of Prince Demidoff will soon be concluded. The metal is quoted in St. Petersburg at 20,500@21,000 rubles per pood; at Ekaterinburg at 5.25 rubles per zolotnik, both of crude platinum 83 per cent. metal. These are equal to averages of $20.09 and $19.74 per oz., respectively.

Silver—The market continues steady. Supplies are absorbed at current quotations, and fluctuations are confined within narrow limits. China shows some disposition to buy, and this fact assists in steadying the price.

SILVER AND STERLING EXCHANGE

Sept.	23	24	25	27	28	29
New York....	51¼	51¼	51¼	51⅛	51⅛	51¼
London.....	23½	23½	23½	23⅝	23⅝	23½
Sterling Ex..	4.8610	4.8615	4.8610	4.8605	4.8605	4.8605

New York quotations, cents per ounce troy, fine silver; London, pence per ounce sterling silver, 0.925 fine.

Exports of silver from London to the East, Jan. 1 to Sept. 16, as reported by Messrs. Pixley & Abell:

	1908.	1909.	Changes.
India.....	£ 6,557,063	£4,576,200	D. £1,980,863
China.....	516,400	1,555,200	I. 1,038,800
Straits.....	112,385	82,800	D. 29,585
Total.....	£ 7,185,848	£6,214,200	D. £ 971,648

Receipts for the week £10,000 from New Zealand, £4000 from Mexico and £170,000 from New York; total, £184,000. Exports, £1000 to Port Said and £232,000 to India; £233,000 in all.

Copper, Tin, Lead and Zinc

Sept.	Copper. Lake, Cts. per lb.	Copper. Electrolytic, Cts. per lb.	Copper. London, £ per ton.	Tin. Cts. per lb.	Lead. New York, Cts. per lb.	Lead. St. Louis, Cts. per lb.	Zinc. St. Louis, Cts. per lb.
23	13 @13⅜	12¾ @13	59⅛	30¼ @30⅜	4.32½ @4.35	4.20 @4.22½	5.67½ @5.70
24	13 @13⅜	12¾ @13	59⅛	30⅜ @30⅝	4.32½ @4.35	4.20 @4.22½	5.70 @5.72½
25	13 @13⅜	12¾ @13	....	30⅜ @30⅝	4.32½ @4.35	4.20 @4.22½	5.72½ @5.75
27	13 @13⅜	12¾ @13	59½	30⅜ @30⅝	4.32½ @4.35	4.20 @4.22½	5.75 @5.77½
28	13 @13⅜	12¾ @13	59¼	30¾ @31	4.32½ @4.35	4.20 @4.22½	5.77½ @5.80
29	13 @13⅜	12¾ @13	59¼	30¾ @30⅞	4.32½ @4.35	4.20 @4.22½	5.77½ @5.80

London quotations are per long ton (2240 lb.) standard copper. The New York quotations for electrolytic copper are for cakes, ingots and wirebars, and represent the bulk of the transactions made with consumers, basis, New York, cash. The prices of casting copper and of electrolytic cathodes are usually 0.125c. below that of electrolytic. The quotations for lead represent wholesale transactions in the open market. The quotations on spelter are for ordinary Western brands; special brands command a premium.

Copper—There has been no special feature to the market during the past week. A moderate business is reported both for home trade and export at current prices. While the consumption in this country has probably reached a point not very far from the highwater mark, buyers are not in a hurry to cover their requirements on account of the statistical position. Producers, on the other hand, are not pressing their output for sale, as they consider present prices fairly safe. The close is steady and unchanged at 13@13⅜c. for Lake copper and 12¾@13c. for electrolytic copper in cakes, wirebars or ingots. Casting copper is quoted nominally at 12⅝@12⅞ cents.

There is no truth in the gossip that a copper consolidation is going to be effected, or even is being seriously considered. This idle talk recurs every little while with no more foundation than the brains of newspaper writers, or perhaps the visions of inconsequential promoters.

Copper sheets are 17@18c., base for large lots. Full extras are charged, and higher prices for small quantities. Copper wire is 14½c. base, carload lots at mill. Business continues on a good scale.

The standard market in London fluctuated within narrow limits during the entire week, showing throughout a good undertone. The close is steady at £59 5s. for spot, and £60 2s. 6d. for three months.

Refined and manufactured sorts we quote: English tough, £62 10s.; best selected, £61 10s.@62 10s.; strong sheets, £73 10s.@74 10s. per ton.

Copper in September—During the first week of September copper was rather dull, business not being heavy while the market was considerably disturbed by some large sales of metal from second-hands. A considerable part of these sales, it was reported, were for the account of a speculator who had bought heavily but was obliged to liquidate, being unable to carry his holdings. By Sept. 10, however, this copper appeared to have been pretty well cleaned up and there was less pressure to sell from second-hands. On the other hand there was more offered from first hands, especially after the publication of the producers' statistics which showed an increase of 12,600,000 lb. in stocks during August. Electrolytic continued to be offered at somewhat below 13c., although it is certain that consumption has reached a very high level. About the middle of the month a decided revival was manifested in the demand for export, although the European statistics for the first half

of the month showed an increase of something like 2000 tons in the visible supplies. These sales supported the market, although they caused no advance, and domestic consumers, finding that there was little probability of any further yielding, began to come in rather freely. The same condition prevailed during the closing week, prices remaining firm, but not advancing. Business was fairly large but producers showed a willingness to sell at current quotations. Lake copper showed an unusualy wide range.

Tin—An enormous speculation has developed in the London tin market, and under large transactions prices have advanced from day to day. The movement appears to be based on the belief of a bigger consumption, particularly in this country, due to the expansion in the tinplate business. So far, neither dealers nor consumers have taken a full interest in the movement and the market here on this account has been rather irregular and at times below the importation point. The close in London is slightly reactionary at £140 for spot and £141 2s. 6d. for three months, while business here is being done at 30¾@30⅞ cents.

Lead—The market is quiet and unchanged at 4.32½@4.35c. New York, and 4.20@4.22½c. St. Louis.

The London market has shown more strength than for a great many months past, and closes higher at £13 2s. 6d. for Spanish, and £13 5s. for English lead.

Spelter—The demand for this metal from all sources continues on an increasing scale, and can only be satisfied by offering to pay higher prices from day to day. The close is firm at 5.92½@5.95c. New York, and 5.77½@5.80c. St. Louis.

New York quotations for spelter on Sept. 23 were 5.82½@5.85c.; 24, 5.85@5.87½c.; 25, 5.87½@5.90c.; 27, 5.90@5.92½c.; 28 and 29, 5.92½@5.95 cents.

The London market is also somewhat higher at £23 2s. 6d. for good ordinaries and £23 7s. 6d. for specials.

Base price of sheet zinc is 7½c. per lb., f.o.b., LaSalle-Peru, Ill., less 8 per cent. discount.

Other Metals

Antimony—Business is quiet and prices unchanged at 8⅝@8¾c. for Cookson's; 8⅜c. for Hallett's; 8@8¼c. for U. S., and 7⅝@7⅞c. for outside brands.

Aluminum—No change can be reported. No. 1 ingots can be had at 20@23c. per lb. in large lots, with the American maker holding to the higher figure.

Quicksilver—Business is good and prices hold the recent advance. New York quotations are $46 per flask of 75 lb., with jobbers asking 63@65c. per lb. for small lots. San Francisco prices hold at $44@45 for domestic orders and $42@43 for export. The London price is now £8 7s. 6d., with second hands selling at £8 6s. per flask.

Magnesium—The price of pure metal is now $1.50 per lb. for 100-lb. lots f.o.b. New York.

Nickel—Large lots, contract business, 40@45c. per lb. Retail spot, from 50c. for 2000-lb. lots, up to 55c. for 500-lb. lots. The price for electrolytic is 5c. higher.

Cadmium—Current quotations are 75c. per lb. in 100-lb. lots at Cleveland, Ohio. In Germany 450@475 marks per 100 kg., at factory in Silesia.

Zinc and Lead Ore Markets

Joplin, Mo., Sept. 25—The high price of zinc sulphide ore was $52 per ton, the base price of 60 per cent. zinc ranging from $49 down to $45; zinc silicate ore sold on a base of $22@25 per ton of 40 per cent. zinc, the high price being $31. The average price, all grades, was $43.58, a decrease of $1 per ton, owing to increased sales of low-grade sulphide and of silicate ores. No higher price than $56 per ton was reported paid for lead, and the average, all grades, was $55.30. An unexpected slump in output was noted for the previous week, but this week shows it on the increase again.

SHIPMENTS, WEEK ENDED SEPT. 25.

	Zinc, lb.	Lead, lb.	Value.
Webb City-Carterville	3,504,860	896,010	$105,475
Joplin	2,206,650	252,980	59,417
Miami	521,810	347,420	18,162
Galena	645,690	66,450	16,677
Duenweg	696,900	160,190	16,664
Aurora	727,520	31,950	16,545
Carthage	497,890	.....	11,948
Prosperity	315,340	137,180	11,058
Jackson	474,830	.....	10,921
Badger	463,050	.....	10,881
Alba-Neck	429,890	.....	10,317
Spurgeon	496,630	38,240	9,594
Quapaw	221,520	29,380	5,696
Sarcoxie	273,040	.....	4,565
Granby	272,900	11,500	4,100
Shoalsburg	242,500	3,760	3,377
Carl Junction	131,050	.....	3,376
Zincite	74,910	.....	1,873
Cave Springs	62,590	.....	1,502
Stott City	57,780	.....	1,444
Peoria	60,130	.....	842
Totals	12,377,480	1,975,060	$324,334
Nine months	439,707,080	66,705,860	$10,394,924
Zinc value, the week, $269,712;		9 mos.,	$8,576,445
Lead value, the week, 54,622;		9 mos.,	1,818,479

MONTHLY AVERAGE PRICES.

Month.	Zinc Ore. Base Price.		Zinc Ore. All Ores.		Lead Ore. All Ores.	
	1908.	1909.	1908.	1909.	1908.	1909.
January	$37.60	$41.25	$35.56	$38.46	$46.88	$52.17
February	36.63	36.94	34.92	34.37	49.72	50.50
March	36.19	37.40	34.19	34.71	49.90	50.82
April	35.40	38.63	34.08	37.01	52.47	55.63
May	34.19	40.06	33.39	37.42	56.05	56.59
June	33.06	44.15	32.07	40.35	60.48	57.52
July	34.55	43.06	31.67	41.11	59.90	53.74
August	36.53	48.25	33.42	44.54	60.34	57.60
September	37.63	.....	34.44	.....	54.59	.....
October	35.95	.....	33.28	.....	52.63	.....
November	39.13	.....	35.02	.....	54.53	.....
December	42.75	.....	39.63	.....	49.68	.....
Year	$36.63	.....	$34.31	.....	$53.93	.....

NOTE—Under zinc ore the first two columns give base prices for 60 per cent. zinc ore; the second two the average for all ores sold. Lead ore prices are the average for all ores sold.

Platteville, Wis., Sept. 25—The base price paid this week for zinc ore, 60 per cent., was $48 per ton. The base price paid for lead ore, 80 per cent., was $55@57 per ton.

SHIPMENTS, WEEK ENDED SEPT. 25.

Camps.	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Harker	429,780	.....	.....
Hazel Green	374,200	.....	.....
Highland	361,160	.....	.....
Cuba City	346,130	157,150	66,410
Linden	303,800	.....	.....
Shullsburg	280,000	.....	.....
Platteville	243,400	.....	249,000
Galena	209,000	.....	.....
Benton	214,400	.....	55,400
Livingston	140,000	.....	.....
Rewey	58,200	.....	.....
Total	2,960,070	157,150	370,810
Year to Sept. 25	100,420,010	6,168,250	9,271,915

In addition to the above there was shipped to the American Zinc Ore Separating Company, 498,300 lb. and to the Joplin Separator Works, 160,000 lb. zinc concentrates.

Chemicals

New York, Sept. 29—The general market is dull for the present, but there is little change in prices.

Copper Sulphate—Business is light but prices are unchanged at $4.10 per 100 lb. for carload lots and $4.35 per 100 lb. for smaller orders.

Arsenic—The market is dull, the buying reported last week having entirely subsided. Quotations for white arsenic are 2.70@2.75c. per lb. for spot, and 2.87½c. for futures.

Nitrate of Soda—The market is very quiet; quotations are 2.10c. per lb. for both spot and futures.

Mining Stocks

New York, Sept. 29—The Stock Exchange has been somewhat erratic during the past week, showing no definite tendency but rather an inclination to react on slight causes. It has been almost wholly a professional market, the public being generally absorbed by the celebrations which were going on during the week. The exception to the lower tendency was found in the steel stocks which displayed remarkable strength throughout the week, and which may be said to have saved the market from a general break.

Sales of 310 shares of Homestake, of South Dakota, were reported during the week at $93@93.75 per share.

The Curb market was rather dull for the most part and was even more affected by the celebrations than the Exchange. Copper stocks were irregular and in some cases lower, the most notable instance being Cumberland-Ely, which lost considerably, although no special cause can be given. Cobalt stocks were generally steady but by no means active. The Nevada gold stocks were in much the same condition with comparatively little trading.

Boston, Sept. 28—Copper shares are neglected, although the tone of these specialties remains good. At times the absence of buying spurs the trading element to take a turn on the short side, but it is short-lived, and prices quickly recover. Saturday last, when the New York Exchange suspended to celebrate the Hudson-Fulton festivities, Boston remained open, which is the second instance of this kind in its history. The experiment was worth adopting and if it had not been for the fact that western wires were out of commission, due to the previous night's storm, the results would have been perfectly satisfactory.

The strike in the Butte mining camp had little or no effect on mining shares. North Butte has now a steady market and the price is up almost $4 to $62.37½. There is a disposition to buy this stock without advancing the price. The Amster stocks have been in the fore. Arizona Commercial is up almost $4 for the week to $48.25. A block of the stock was purchased privately just before the death of of Director C. H. Paine, so that the latter's demise had no effect on the price.

Atlantic's $2 assessment caused weakness in the stock and the price fell to $8.50. Amalgamated, which took a sudden drop to $82, more than recovered the decline. This stock is more scarce in brokers' offices than ever.

Curb stocks are generally selling at slightly lower levels. Cumberland-Ely has gone off over $1 to below $6, with no accompanying explanation.

STOCK QUOTATIONS

NEW YORK Sept. 29	
Name of Comp.	Clg.
Alaska Mine	‡.11
Amalgamated	83½
Anaconda	49¼
Balakiala	‡2⅛
British Col. Cop.	7
Buffalo Mines	3⅛
Butte Coalition	25¾
Colonial Silver	‡⅛
Cum. Ely Mining	6⅞
Davis-Daly	5⅞
Dominion Cop.	7
Douglas Copper	⅛
El Rayo	2⅞
Florence	2⅛
Foster Cobalt	‡.32
Furnace Creek	‡.05
Giroux	9
Gold Hill	⅛
Goldfield Con	6⅛
Granby	100
Greene Gold	‡⅛
Greene G. & S.	‡9
Guanajuato	2⅛
Guggen. Exp.	215
Hanapah	‡15
Kerr Lake	9⅛
McKinley-Dar.	.93
Miami Copper	16¼
Micmac	⅛
Mines Co. of Am.	⅛
Montezu. of C. R.	16
Mont. Sho. C.	2
Nev. Utah M. & S.	1⅛
Newhouse M. & S.	2⅞
Nipissing Mines	12⅛
Old Hundred	⅛
Silver Queen	.39
Stewart	⅛
Tennessee Cop'r.	36¾
Tri-Bullion	⅛
United Copper	10¼
Utah Apex	4¼
Utah Copper	49⅝
Yukon Gold	5⅛

‡Last quotation.

BOSTON Sept. 29	
Name of Comp.	Clg.
Adventure	6¾
Allouez	58½
Am. Zinc	32¾
Arcadian	5
Arizona Com.	48
Atlantic	8½
Boston Con.	15¼
Calumet & Ariz.	104
Calumet & Hecla	675
Centennial	40½
Copper Range	80½
Daly-West	8
East Butte	11¾
Franklin	17⅞
Greene—Can.	9
Hancock	10
Isle Royal	24
Keweenaw	2½
La Salle	15¼
Mass.	7½
Michigan	10½
Mohawk	62
Nevada	24¼
North Butte	61¾
Ojibway	8½
Old Colony	.65
Old Dominion	.54
Osceola	151
Parrot	31¼
Quincy	90
Rhode Island	‡4¾
Shannon	16¾
Superior	58
Superior & Bost.	15¾
Superior & Pitts.	15¾
Tamarack	70
Trinity	12
U. S. Smg. & Ref.	57¾
U.S.Sm. & Re., pd.	53¾
Utah Con.	44¾
Victoria	3¾
Winona	7¾
Wolverine	152
Wyandotte	2¼

‡Last quotation.

N. Y. INDUSTRIAL	
Am. Agri. Chem.	46½
Am. Smelt. & Ref.	99½
Am.Sm. & Ref., pf.	112¾
Colo. Fuel & Iron.	46½
Federal M. & S., pf.	‡91½
National Lead	90½
National Lead, pf.	111
Pittsburg Coal	20⅞
Republic I. & S.	48⅜
Republic I. & S., pf.	108
Sloss-Sheffield	90⅛
Standard Oil	‡685
U. S. Steel	89⅛
U. S. Steel, pf.	129⅜
Va. Car. Chem.	47½

BOSTON CURB	
	Low.
Ahmeek	225
Chemung	16
Chino	8⅛
Gila	8¾
Indiana	6¾
Mason Valley	2
Ray Central	2⅛
Ray Con.	19¾
San Antonio	8
Yuma	1⅛

Furnished by Hornblower & Weeks, N. Y.

ST. LOUIS Sept. 25		
N. of Com.	High.	Low.
Adams	.40	.36
Am. Nettie	.09	.07
Center Cr'k	1.75	1.60
Cent. C. & C.	86.00	84.00
C. C. & C. pf.	85.00	83.00
Cent. Oil	120.00	100.00
Columbia	9.00	7.00
Con. Coal	18.00	17 00
Doe Run	115.00	100.00
Gra. Bimet.	.30	.25
St. Joe	12.50	11.00

LONDON Sept. 29			
Name of Com.	Clg.		
Dolores	£1	5s	0d
Stratton's Ind.	0	3	3
Camp Bird	1	9	6
Esperanza	3	1	0
Tomboy	0	19	0
El Oro	1	5	6
Oroville	0	14	0

Cabled through Wm. P. Bonbright & Co., N. Y.

NEVADA STOCKS. Sept. 29.
Furnished by Weir Bros. & Co., New York.

Name of Comp.	Bid.	Name of Comp.	Bid.
COMSTOCK STOCKS		Silver Pick	.12
Belcher	.90	St. Ives	.05
Best & Belcher	.56	Triangle	.01
Caledonia	.35	BULLFROG STOCKS	
Chollar	.25	Gibraltar	.02
Comstock	‡.28	Homestake King.	‡ 01
Con. Cal. & Va.	‡1.25	Mont. Shoshone C.	1.87½
Crown Point	.89	Tramp Cons	.04
Exchequer	.31	MISCELLANEOUS	
Gould & Curry	.21	Cumberland Ely.	6.50
Hale & Norcross	.60	Giroux	9.25
Mexican	1.27	Greenwa'r Copper	.04
Ophir	1.15	Nevada Con.	24.37½
Overman	.70	Nevada Hills	.70
Potosi	.59	Navada Smelting	.87½
Savage	.53	Nevada Wonder	.70
Sierra Nevada	.46	Nevada-Utah	1.56¼
Union	.66	Penn-Wyoming	...
Utah	.05	Pittsburgh S. Pk.	.65
Yellow Jacket	1.40	Ray Central	2.25
TONOPAH STOCKS		Ray Con.	19.75
Belmont	.73	Round Mt. Sphinx	05
Extension	.57		
Golden Anchor	...		
Jim Butler	.12		
MacNamara	.29		
Midway	.18		
Montana	.97		
North Star	.02		
Tono'h Mine of N.	7.00		
West End Con.	.27		
GOLDFI'D STOCKS			
Adams	.01		
Atlanta	.12		
Blue Bell	.02½		
Booth	.11		
C.O.D. Con.	.08		
Columbia Mt.	.08		
Comb. Frac.	.82		
Cracker Jack	.02		
Dia'dfield B. B. C.	.01		
Florence	2.75		
Goldfield Belmont	.04		
Goldfield Daisy	.11½		
Great Bend	.04		
Jumbo Extension	.15		
Kendall	.02		
Lone Star	.02		
May Queen	.04		
Oro	.04		
Red Hill	.05		
Sandstorm	.06		

COLO. SPRINGS Sept. 24	
Name of Comp.	Clg.
Acacia	.07¾
C. C. Con.	.03¼
Doctor	.09¾
Elkton	.75
El Paso	.63½
Findlay	.12
Gold Dollar	.13¾
Gold Sovereign	.04¼
Isabella	.18¾
Jack Pot	‡.08½
Jennie Sample	.08
Jerry Johnson	.06½
Lexington	‡.01¾
Mary McKinney	.48
Old Gold	.04½
Pharmacist	‡.03½
Portland	.83¾
U. G. M.	.08
Vindicator	.74
Work	‡ 07

Assessments

Company.	Delinq.	Sale.	Amt.
Alta Gladstone, Utah	Sept. 15	Oct. 20	$0.00½
Andes, Nev.	Sept. 14	Oct. 5	0.10
Arcadian, Mich.	Sept. 1	Sept. 31	0.50
Bonanza Mt. Copper, Ida.	Sept. 7	Oct. 7	0.001
Brunswick Con. Va., Nev.	Oct. 1	Oct. 22	0.02
Bullion, Nev.	Oct. 7	Oct. 25	0.05
Challenge Con., Nev	Sept. 28	Oct. 18	0.10
Con. Imperial, Nev.	Sept. 15	Oct. 7	0.01
Copper Mt. M. & D., Ida.	Sept. 7	Oct. 4	0.003
East Buffalo, Ida.	Sept. 10	Oct. 10	0.000½
Hale & Norcross, Nev.	Sept. 21	Oct. 11	0.10
Hancock Con., Mich.	Oct. 10		1.00
Julia Con., Nev.	Oct. 14	Nov. 8	0.03
Mexican, Nev.	Sept. 10	Oct. 4	0.10
San Antonia Copper, Mex.	Dec. 1		1.00
Sheba G. & S. Mining, Utah	Sept. 28	Oct. 30	0.05
Sierra Nevada, Nev.	Oct. 12	Nov. 3	0.10
Silver King Con., Utah	Oct. 4	Oct. 23	0.10
So. Columbus Con., Utah	Sept. 20	Oct. 20	0.000½
Wilbur Min. Co., Ida.	Sept. 13	Oct. 8	0.05
Winona Mich.	Sept. 14		1.00

Monthly Average Prices of Metals

SILVER

Month.	New York.		London.	
	1908.	1909.	1908.	1909.
January	55.678	51.750	25.738	23.834
February	56.000	51.472	25.855	23.706
March	55.365	50.468	25.570	23.227
April	55.505	51.428	25.133	23.708
May	52.795	52.905	24.377	24.343
June	53.663	52.538	24.760	24.166
July	53.115	51.043	24.514	23.519
August	51.683	51.125	23.858	23.588
September	51.720	.....	23.877	.....
October	51.431	.....	23.725	.....
November	49.647	.....	22.933	.....
December	48.766	.....	22.493	.....
Total	52.864	.....	24.402	.....

New York, cents per fine ounce; London, pence per standard ounce.

COPPER

	NEW YORK.				LONDON.	
	Electrolytic		Lake.			
	1908.	1909.	1908.	1909.	1908.	1909.
January	13.726	13.893	13.901	14.280	62.386	57.688
February	12.905	12.949	13.098	13.295	58.786	61.198
March	12.704	12.387	12.875	12.826	58.761	56.231
April	12.743	12.56½	12.928	12.93¾	58.331	57.363
May	12.598	12.893	12.788	13.238	57.387	59.338
June	12.675	13.214	12.877	13.548	57.842	59.627
July	12.702	12.880	12.933	13.363	57.989	58.556
August	13.462	13.007	13.639	13.296	60.500	59.393
September	13.388	.....	13.600	.....	60.338	.....
October	13.354	.....	13.646	.....	60.139	.....
November	14.130	.....	14.386	.....	63.417	.....
December	14.111	.....	14.411	.....	62.943	.....
Year	13.208	.....	13.424	.....	59.902	.....

New York, cents per pound. Electrolytic is for cakes, ingots or wirebars. London, pounds sterling, per long ton, standard copper.

TIN AT NEW YORK

Month.	1908.	1909.	Month.	1908.	1909.
January	27.380	28.060	July	29.207	29.125
February	28.978	28.290	August	29.942	29.966
March	30.577	28.727	September	28.815	.....
April	31.702	29.445	October	29.444	.....
May	30.015	29.225	November	30.348	.....
June	28.024	29 322	December	29.154	.....
			Av. year	29.465	.....

Prices are in cents per pound.

LEAD

Month.	New York.		St. Louis	London.	
	1909.	1909.	1909.	1908.	1909.
January	3.691	4.175	4.025	14.469	13.113
February	3.725	4.018	3.868	14.250	13.313
March	3.838	3.986	3.835	13.975	13.438
April	3.993	4.168	4.051	13.469	13.297
May	4.253	4.287	4 214	12.938	13.225
June	4.466	4.350	4.291	12.600	13.031
July	4.744	4.321	4.188	13.000	12.563
August	4.580	4.363	4.227	13.375	12.475
September	4.515	.....	.....	13.125	.....
October	4.351	.....	.....	13.375	.....
November	4.330	.....	.....	13.538	.....
December	4.213	.....	.....	13.156	.....
Year	4.200	.....	.....	13.439	.....

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

SPELTER

Month.	New York.		St. Louis.		London.	
	1908.	1909.	1908.	1909.	1908.	1909.
January	4.513	5.141	4.363	4.991	20.563	21.425
February	4.788	4.889	4.638	4.739	20.875	21.563
March	4.665	4.757	4.527	4.607	21.075	21.438
April	4.645	4.965	4.495	4.815	21.344	21.531
May	4.608	5.124	4.458	4.974	19.906	21.975
June	4.543	5.402	4.393	5.252	19.000	22.000
July	4.485	5.402	4.338	5.252	19.031	21.969
August	4.702	5.729	4.556	5.579	19.350	22.125
September	4.769	.....	4.619	.....	19.563	.....
October	4.801	.....	4.651	.....	19.750	.....
November	5.059	.....	4.909	.....	20.875	.....
December	5.137	.....	4.987	.....	20.625	.....
Year	4.726	.....	4.578	.....	20.163	.....

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

CHEMICALS, MINERALS, RARE EARTHS, ETC.—CURRENT WHOLESALE PRICES.

ABRASIVES—		
Carbons, good drill quality, carat		$50.00@75.00
Carborundum, f.o.b. Niagara Falls, powd.	lb.	.08
Grains	"	.10@.17
Corundum	"	.07@.10
Crushed Steel, f.o.b. Pittsburg	"	.05½@.06
Emery, in kegs; Turkish flour	"	.01½@.02
Grains	"	.03½@.04
Naxos flour	"	.01½@.02
Grains	"	.03½@.04
Chester flour	"	.01½@.02
Grains	"	.03½@.04
Peekskill flour, f.o.b. Easton, Pa	"	.01½@.01¾
Grains, in kegs	"	.02¼@.03
Garnet, per quality	sh. ton.	25.00@35.00
Pumice Stone, Am. Powd., 100 lb.		1.60@2.00
Italian, powdered	per lb.	.01¾@.01¼
Lump, per quality	"	.05@.30
Rottenstone, ground	"	.02@.04
Lump, per quality	"	.05@.30
Rogue, per quality	"	.05@.30
Steel Emery, f.o.b. Pittsburg	"	.07½@.07¾
ACIDS—		
Acetic 28%	lb.	.02½
Boric	"	.07
Hydrofluoric, 30%	"	.02¾@.03½
" 48%	"	.06
" 52%	"	.06½
" 60%	"	.10
Hydrochloric acid, 20°, per lb.		1.25@1.50
Nitric acid, 38°	per lb.	.04½@.04½
Sulphuric acid, 50°, bulk per ton.		$12 up
60°, 100 lb. in carboys.		.85@1.12½
60°, bulk, ton		16.00@18.00
66°, 100 lb. in carboys.		1.00@1.10
66°, bulk, ton		18.00
Oxalic	per lb.	.07¾@.08¾
ALCOHOL—Grain 95%	gal.	2.64½
Denatured	"	.43@.45
Refined wood, 95@97%	"	.50@.55
ALUM—Lump	100 lb.	$1.75
Ground	"	1.85
Chrome Alum	"	.03¾@.05
ALUMINUM—Sulphate, com'l.	lb.	1.50@1.75
AMMONIA—24 deg. lb.	"	.04½@.05½
" 26 deg. lb	"	.04¾@.05¾
AMMONIUM—		
Bromide	lb.	.28
Carbonate	"	.07½@.09½
Muriate grain	"	.05½@.06½
Lump	"	.09½@.09½
Sulphate, 100 lb.		2.62½@2.67
Sulpho-cyanide com		.30
" chem. pure		.40
ANTIMONY—needle, lump	"	.04@.04½
ARSENIC—white	"	.02¾@.03
Red, Outside brands	"	.06@.07
Saxony	"	.07½@.08
ASPHALTUM—		
Barbadoes	per ton.	50.00@80.00
West Indies	"	20.00@60.00
Egyptian	lb.	.11@.16
Gilsonite, Utah ordinary	per ton.	32.00@40.00
Trinidad	"	20.00@25.00
California	"	25.00@30.00
BARIUM—		
Carb. Lump. 80@90%	lg. ton.	30.00@35.00
Precipitated 96@98%		36.00@40.00
Powdered, 80@90%	lb.	.02@.02¼
Chloride com'l	ton.	36.00@39.00
Nitrate powdered, in casks	lb.	.05@.06½
Blanc Fixe, dry, bbl.	per lb.	.02½@.04
BARYTES—		
Am. Ground	sh. ton.	12.00@17.00
Floated	"	17.00@20.00
Foreigd floated	"	20.00@22.00
BLEACHING POWDER—35% 100 lb.		1.25@1.50
BLUE VITRIOL—(copper sulphate), carload, per 100 lb.		3¾@4.35
BONE ASH	lb.	.02½@.04
BORAX, sacks	"	.04½@.05
CALCIUM—Acetate, gray, 100 lb.		1.75@1.80
Carbide, ton lots f.o.b. Niagara Falls, N. Y., for Jersey City, N. J.	sh. ton.	65.00
Chloride, f.o.b. N. Y.	"	11.00@14.10
CEMENT—		
Portland, Am. 500 lb	bbl.	1.50@1.60
Foreign	"	2.25@2.90
"Rosendale," 300 lb.	"	.85
(in sacks)	"	.65
Slag cement	"	.75@1.25
CHROME ORE—		
New Caledonia 50% ex. ship N. Y.	per lg. ton.	14.00@16.00
Bricks, f.o.b. Pittsburg, per M.		175.00
CLAY, CHINA—Am. common ex-dock, N. Y.	ton,	7.00@10.00
Foreign	"	10.00@17.50
COBALT—Oxide	lb.	1.10@1.75
COPPERAS—Bulk	100 lb.	$0.55
In bbls	"	.65@.75
In bags	"	.60@.70
CRYOLITE (carload)	lb.	.06@.07
FELDSPAR—Ground	sh. ton.	12.50@14.00
FIRE BRICK—		
American	per M.	30.00@40.00
Imported	"	30.00@45.00
St. Louis	"	16.00
Extra	"	20.00@23.00
Special extra	"	30.00@35.00
FIRE CLAY—F.o.b. St. Louis.		
St. Louis, extra quality	per ton.	5.00
" ordinary	"	2.50
FLUORSPAR—		
Domestic f.o.b. shipping port:		
Lump	lg. ton.	8.00@10.00
Ground	"	12.00@14.00
Foreign crude ex. dock		8.00@10.00
FULLER'S EARTH—Lump, 100 lb.		.80@.85
Powdered	"	.80@.85
GRAPHITE—Ceylon.		
Flying dust, finest to best	lb.	.02½@.04
Dust	"	.02½@.05
Chip	"	.04@.08
Lump	"	.05½@.12
Large lump	"	.08¼@.10½
GYPSUM—		
Fertilizer	sh. ton.	5.00
Ground	"	4.00@7.00
INFUSORIAL EARTH—		
Ground Am. Best	lb.	.01¾@.02½
German	"	.02¼@.02⅝
LEAD—Acetate (sugar of) brown,	lb.	.07¾@.08
Nitrate, com'l	"	.07⅛@.08½
MAGNESITE—Greece.		
Crude (95%)	lg. ton.	7.50@8.50
Calcined, powdered	sh. ton.	26.00@37.00
Bricks, domes, per qual. f.o.b. Pittsburg	M.	160@200
MAGNESIUM—		
Chloride, com'l	100 lb.	.90@1.25
Sulphate (Epsom salt)	100 lb.	.90@1.00
MANGANESE—		
Foreign, crude, powdered:		
70@75% binoxide	lb.	.01@.01½
75@85% binoxide	"	.01½@.01½
85@90% binoxide	"	.01½@.04
90@95% binoxide	"	.06½
Ore, 80%-85%	sh. ton.	16.00@32.50
MARBLE—Flour	sh. ton.	8.50@9.00
MINERAL WOOL—		
Slag, ordinary	sh. ton.	19.00
Selected	"	25.00
Rock, ordinary	"	32.00
MONAZITE SAND—		
Guar. 97%, with 5% Thorium oxide, normal	lb.	.08 and up
NICKEL—		
Oxide, crude, lb. (77%) for fine metal contained		.47
Sulphate, single	lb.	.09@.11
Sulphate, double	"	.06½@.08
NITRATE OF SODA—		
100 lb. 95%		2.10
95% for 1910		2.10
96% is 2½@7½c. higher per 100 lb.		
OZOKERITE—best	lb.	.14@.17
PAINTS AND COLORS—		
Litharge, Am. powdered	lb.	.05½@.06½
English glassmakers'	"	.08½@.09½
Lithopone	"	.03½@.07
Metallic, brown	sh. ton.	16.50@22.00
Red	"	14.00@18.00
Ocher, Am. common	"	8.50@9.00
Best	"	16.00
Dutch, washed	lb.	.02½@.03
French, washed	"	.01½@.02
Paris green, pure, bulk	"	.17½@.20½
Red lead, American	"	.06@.06½
Foreign	"	.08½@.09½
Turpentine, spirits bbl., per gal.		.58@.60
White lead, Am., dry	lb.	.05⅞@.05⅞
American, in oil	"	.06½@.07
Foreign, in oil	"	.09½@.09⅞
Zinc white, Am. extra dry	"	.05⅛@.05⅛
French, proc's, red seal, dry	"	.06⅛@.07⅛
French, process, green seal, dry	"	.07¼@.10½
PHOSPHATES—Acid		55@60c. per unit
*Fla., hard rock 77%		6.50@9.00
land pebble 68%		3.75@4.00
†Tenn., 78@80%		5.00@5.50
75%		4.75@5.00
68@72%		4.25@4.50
‡So. Car. land rock 60%		3.50@4.00

*F.o.b. Florida or Georgia ports. †F.o.b. Mt Pleasant. ‡On vessel Ashley River, S. C.

POTASSIUM—		
Bicarbonate crystal	lb.	$.07½
Powdered or granulated	"	.08
Bichromate, Am.	"	.07⅝@.08
Scotch	"	.10½
Bromide	"	.20
Carbonate (80@85%)	"	.03⅝@.04
Caustic, ordinary	"	.05½@.06
Elect. (90% KOH)	"	.06
Chloride (muriate), 100 lb.		1.90
Chlorate, powdered	"	.09½@.09⅝
Crystals	"	.09@.09½
Cyanide (98@99%)		
Carloads (30,000 lb.)	"	18c.
5-ton lots		18½c.
Less than 5 tons		.20@.22½
Kainite, long ton, bulk, 8.50; bags,		9.50
Permanganate	lb.	.09½@.10½
Prussiate, yellow	"	.13@.13½
Red	"	.30@.33
Sulphate (basis 90%)	100 lb.	2.18@2.21
PYRITE—		
Domestic, non-arsenical, furnace size, f.o.b. mines	per unit.	11@11½c.
Domestic, non-arsenical, fines, per unit, f.o.b. mines		10@10½c.
Imported, non-arsenical, furnace size, ex-ship, per unit		.12@.12½
Imported, arsenical, furnace size, ex-ship, per unit		.11½@.12
Imported fines, arsenical, ex-ship, per unit		.09
Imported fines, non-arsenical, ex-ship, per unit		10½@11c.

Pyrite prices are per unit of sulphur. A deduction of 25c. per ton is made when ore for furnace is delivered in large lumps.

SALT—N. Y. com. fine 280 lb.	bbl.	.72@1.13
N. Y. agricultural	sh. ton.	3.80@4.50
SALTPETER—Crude	100 lb.	4.00@4.50
Refined, crystals	"	5.50@6.00
SILICA—		
Ground quartz, ord'ry.	lg. ton.	10.00@15.00
Silex, ground	"	13.00@15.00
Silex, floated	"	35.00@40.00
Lump quartz	"	5.00@5.50
Glass sand	"	2.75
SILVER—Nitrate, crystals	oz.	.33½@.36¾
SODIUM—Acetate	lb.	.04½@.05
"Alkali," per 100 lb., 58/48		.80@.87½
Bicarb. soda, per 100 lb		1.00@1.30c.
Soda, caustic, per 100 lb., 78/60		1.75@1.90
Soda, caustic, powdered		.02½@.03
Salt cake, per 100 lb., bulk		.40 up
Salt cake, bbl		.65@.85
Soda, monohydrate, per lb		1.40@1.75
Bichromate	lb.	.05¾@.06½
Bromide	"	.20
Chlorate, com'l	"	.08½@.09½
Cyanide ("100% KCN")		
Carloads (30,000 lb.)	"	18c.
5-ton lots	"	18½c.
Less than 5 tons	"	19c.
Hyposulphite, Am	"	1.30@1.50
Phosphate	100 lb.	2.20@2.50
Prussiate	"	.08½@.09
Sal soda, f.o.b. N. Y.	"	.65@.75
Foreign, f.o.b. N. Y.	"	.80@1.00
Silicate, com'l	"	.65@1.00
Sulphate, com'l (Glauber's salt)	100 lb.	.60@.80
Sulphate, com'l, calcined		.65@.85
STRONTIUM—Nitrate	lb.	.07½@.08
SULPHUR—Louisiana (prime) to New York	lg. ton.	22.00 up
To Boston, Philadelphia or Baltimore	"	22.50 up
Roll	100 lb.	1.85@2.15
Flour		2.00@2.40
Flowers, sublimed	"	2.20@2.60
Sicilian, extra qual., unmixed seconds, crude brimstone to New York	lg. ton.	$22.00
Other ports	"	22.50
TERRA ALBA—Fr. & Eng.	100 lb.	.80@1.00
TALC—Domestic	sh. ton.	15.00@20.00
French	"	18.00@25.00
Italian, best	"	30.00@40.00
TIN—Bi-chloride, 50%	lb.	.09½
Crystals	"	.21½@.22
Oxide, lb.	"	.32½@.35
URANIUM—Oxide	"	3.50@4.25
ZINC—Chloride sol., com. 20°	"	.02½
Chloride, granular	"	.04½
Dust	"	.06¾
Sulphate	"	.02½@.02¾

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THE MINING INDEX

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